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ZOOLOGY, COMPARATIVE ANATOMY, PRACTICAL MECHANICS, GEOGRAPHY,
NAVIGATION, STATISTICS, ANTIQUITIES, AND THE FINE AND USEFUL ARTS.

CONDUCTED BY

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A more narrow mass of overlying trap occurs in the vicinity of the place here in question; and to this may be traced, not only the vein which forms a principal part of the interest of this communication, but many others which exist in the same neighbourhood. To enter on all the interesting circumstances which are visible in this district, and which are connected with this trap, would require a much more extensive detail than is here admissible, and would interfere with the more particular objects of this paper. They must therefore be reserved for another opportunity; and I shall only briefly remark, that, in many places, it presents those interesting appearances which I have described in the Geological Transactions as occurring in the hill of Kinnoul, as well as others of a no less important nature, which are noticed in my account of the Western Islands.

Between the argillaceous schist and the conglomerate, which in general follows it in immediate succession, there are to be seen interposed, in this neighbourhood, one or more masses of a calcareous rock, of which that quarried at Clunie forms the leading object of this communication. I have said one or more, doubtingly; since it has been exposed and quarried in two places, and there is no mode of ascertaining whether these two are independent masses, or parts of the same; and whether or not, similar ones, yet undiscovered, do not exist in the same line. While it has been sometimes too generally concluded that any given stratum was prolonged through a considerable space, such appearances have been supposed to arise from a partial exposure of a single bed; and strata of an indefinite extent have thus been laid down, where only separate and independent masses existed. In this way, the existence of a mass of limestone at the lake of Clunie, would lead us to suppose a bed of calcareous rock continuously interposed between the schist and the conglomerate. I have already mentioned that these are generally in contact; and when the limestone shall be described, there will be further reasons apparent for concluding that it is a detached, unstratified, and independent mass. Whether the two masses above alluded to are one and the same, is a matter of less consequence; and as the appearances which attend the smaller one are of little importance, I shall pass it over altogether, and limit this description to that which appears at Clunie.

This is to be seen near the southern angle of this picturesque and pleasing lake, where it has been quarried to a considerable extent; no less to the advantage of the geologist than to the improvement of the agriculture of this fertile tract of country. By means of this quarry, ready access is obtained to all the peculiar circumstances which distinguish the rock, and the greatest facility is afforded for the selection and comparison of specimens. On one side also its termination has been traced, since the limestone to the eastward has been exhausted by the operations of quarrying; and thus the additional reasons, to which I above alluded, for supposing it an insulated mass, are apparent. A sketch and section (see Plate I. Figs. 1 and 2.) are subjoined to facilitate the apprehension of the circumstances which attend it.

It will be seen that at the eastern end it is every where surrounded by the conglomerate, but its termination westward cannot be discovered. That part which lies on the northern side of the trap vein at this point has been exhausted as far as it has been exposed; and the ground does not admit of its being traced beyond the quarry in a western direction on either side of that vein. On its northern side a portion of clay-slate appears, but immediately separated from it, as well as from the conglomerate, by the trap vein which has made its way between the two; afterwards crossing the body of the limestone, and being lost in the conglomerate; since here also the ground does not permit it to be traced any further. Such are the most obvious appearances.

In examining the relations of the several rocks, no other evidence than that of proximity can be adduced, of the connexion between the schist and the conglomerate, which have already been shown to follow each other in a regular and connected manner throughout the district formerly mentioned. But from that general fact we are entitled to conclude, that the point under examination is one of those where the common boundary of the schist and the conglomerate exists; and that the deficiency of connexion in this place arises, partly from the form of the ground, partly from the disturbance which attends the trap vein, and perhaps also in some degree from the casual occurrence of the independent calcareous rock. It is not so easy to determine the precise position of the limestone with respect to these rocks, but I must premise that it bears no marks whatever of regularity or stratification. It is an irregular mass, displaying every where a set of heterogeneous forms divided by natural seams in various intricate directions, curvilinear as well as straight; and breaking, whether naturally or artificially, into those shapeless fragments which are characteristic of many crystalline limestones, some of which are found in the primary strata, while others, as I have shown in my account of Sky, appertain to the secondary. Its abrupt termination in the conglomerate at its eastern end, serves also to prove the absence of a stratified disposition.

It has been shown that the trap vein prevents its relation of the limestone to the schist from being examined; but it can be readily compared with the conglomerate on the opposite side. That rock is here decidedly stratified, and is seen lying above and to the south of the limestone, dipping southwards in an angle which cannot well be ascertained, but which seems to vary from twenty to thirty degrees. At the contact of the two there is a mutual penetration of parts; the limestone first containing scattered fragments similar to those which form the conglomerate, and which, by their gradual accumulation seem to cause it to graduate into the latter; not, however, preventing us from perfectly distinguishing the one rock from the other, although the conglomerate also contains some calcareous matter at its junction.

It is plain from this description, that the limestone is, in one part, decidedly followed by the whole mass of conglomerate, and consequently of sandstone, in regular order; while no stratified rock is interposed between it and the schist. It lies therefore between the two; and were it determined to be a prolonged stratum, we should have had a bed of calcareous rock interjacent between the schist and the secondary strata. But this part of the difficulty does not remain to contend with, as I have already shown, and as is still further confirmed by the circumstance that, in another place, it is entirely involved in the conglomerate. We must therefore conclude that it is a solitary and independent mass, lying in an oblique direction with regard to the schist and the conglomerate, or rather irregularly, and, as it were, accidentally intruding at the place where these two more regular rocks meet. If its position in this respect is singular, its analogy to the similarly irregular masses which are found in gneiss and in micaceous schist will be apparent; and if we are unable to explain the origin of the one, we are no less at a loss to assign that of the other.

Under the circumstances described, it will be asked whether this is a primary or a secondary limestone. This question appears not to require an answer. There has been a time when its irregularity, and the absence of the stratified structure, would probably have decided its place among the primary rocks, or at least among those which have been called *transition*; but as I have, on other occasions, shown that the same characters are found among the more decidedly secondary limestones, it is an insufficient ground for judgment: its natural history is not the less intelligible, and may perhaps be more useful, if divested of such systematic views.

The mineral character of this rock is at once various and remarkable. In its simplest form it is of a grayish, yellowish, or dirty-white colour, rarely green. In fracture it displays almost every variety, the crystalline, the conchoidal, the splintery, the large or small granular, and the earthy; while, in composition, it equally varies. Specimens of the purest carbonate occur in some places; while, in others, it contains silex, argil, or magnesia, separately or mixed, and to such an extent that it almost loses the character of limestone. It is scarcely necessary to add, that its hardness and specific gravity, as well as its economical properties, undergo corresponding variations. The effects of these combinations are abundantly obvious in examining its produce at the kilns; where various glasses, frits, and porcelain-like products, are found rejected by the burners.

Besides these varieties of composition, it contains many independent substances, dispersed throughout it in concretions, or in fragments of different sizes. The most numerous of these are the fragments of the primary rocks which constitute the conglomerate, and which are principally abundant near the places of its contact with that rock. In most of these the iron is highly oxydated, and of a red or purple hue; and similar appearances, both of oxidation and rottenness, are apparent, I may add, every where in the vicinity of these junctions. From this admixture many parts of the rock may be considered as a breccia with a calcareous base; but there is always a gradation between the conglomerate and the simple rock, without any indications denoting a separation of the two, or a line of stratification between them. The limestone itself appears also to have been, in some places, broken into fragments and reunited; and brecciated masses, purely calcareous, are thus dispersed in various parts of it.

Besides the fragments now described, of which many, from the degree of their decomposition and oxidation, possess the characters of burnt clay, nests of a fine pulverulent soft blue clay are to be seen dispersed in various parts of the pure limestone at considerable distances from each other. These vary, from the size and figure of an orange, to pieces of many feet or even yards in extent, and are both perfectly defined, and readily separable from the calcareous rock. Other fragments of a substance less easily defined are also abundant, and they occur principally in the vicinity of the trap. This is a purple clay, containing much iron, having often the aspect of serpentine, until it is broken, when it falls into powder; appearing, like the ironstones, to have decomposed in successive crusts. It is either found in distinct nodules, in irregular veins, or in shapeless masses; and is sometimes accompanied by a green earth, resembling at times steatite, and at others the green earth or chlorite of the trap rocks. This latter mineral is also found, in some places, in considerable abundance, of a slaty or laminar form, confusedly intermixed with the limestone, so as to give the whole a green tinge, and to conceal the nature of the rock, from which it cannot, owing to the intimacy of the admixture, be separated. In the rifts there is also to be seen flesh-coloured and platy sulphat of barytes; and, in larger cavities, the dog-tooth variety of calcareous spar is found crystallized in considerable abundance. But the most remarkable of the independent minerals found in it is chalcedony, or agate, as it may perhaps more intelligibly be called. This is of a yellowish red hue, and is dispersed throughout it in various places. It has the usual aspect and semi-transparency of the cornelians, but is rarely found in distinct nodules. It either forms ramifying veins and reticulations, or is disposed in a granularly aggregated manner amid the limestone, or else it assumes the appearance of large irregular concretions, which, at the edges, become gradually broken and dispersed among the surrounding rock. This mineral is not necessarily connected either with the trap or with the conglomerate boundary, but is found indiscriminately even in the central parts of the rock, from which it is always easily distinguished by the contrast of their respective colours. Grains of transparent quartz may also be here and there observed, and so united to the surrounding materials, that, where this is pure, they are not readily distinguished from the carbonate of lime. The other peculiarities visible in the limestone will be more intelligible when the trap vein has been described.

The general position of that vein may be comprehended from the sketch. Veins of a similar substance are found in a corresponding direction on the north side of the lake; and it is possible that the present is a prolongation of one of them. It is more likely, however, to be distinct, and, like them, a process from the great superincumbent mass, of which indeed the evidence seems sufficiently clear. It passes through the limestone in a curved direction, as may be seen in the plan, proceeding first from the north, and then inclining towards the west. It is erect in position, but not sufficiently even and regular to admit of its inclination being stated. For the same reason its thickness cannot be assigned; but it may be said to vary from three or four yards to thirty or forty. The upper portion of the vein, as will be seen by the sketch, overlies, in some measure, that rock which is merely intersected by its lower one; independently of which it ramifies, sending off branches into the limestone. It is a massive rather than a laminated vein. In its general structure it may be called a greenstone, since that term has commonly been used in a very lax sense; but no felspar can be detected in it by the eye, the whole appearing an uniformly black granular mass. The magnifying glass, however, discovers the felspar, which, from the blackness of its colour, is otherwise easily confounded with the hornblende of the compound. In many places, it betrays a tendency to decompose into laminated spheroidal forms, an appearance much too common to require notice, were it not here particularly conspicuous from the minuteness of the concretions, and the singular effect produced by their accumulation in those parts of the rock where they abound.

But the most interesting circumstance in its composition, independently of the change of substance which it undergoes, is the existence of specular iron. This mineral, however, is confined to one part of the vein; but, where it does occur, it is abundant. It is in scales of different dimensions, rarely exceeding the quarter of an inch, and irregularly intermixed in the rock. In general, those plates are without definite form, but they are also to be found regularly crystallized, assuming the most common figure presented by volcanic specimens, namely, that of a table, or a very short hexagonal prism, of which two opposed sides are much longer than the other four. This fact is valuable, as tending to approximate, in another point, the rocks of the trap family to the products of existing volcanoes.

The greater portion of the rock is of a moderately coarse granular texture, becoming finer as it approaches near to the edge of the vein. Here that change commences which forms the most interesting part of its history. The first step is the acquisition of a finer texture, with a structure approaching by degrees to the laminar, and which gradually becomes more distinct to the very edge of the vein, where it frequently splits off by the progress of decomposition into laminæ, resembling on a cursory view a black shale. These laminæ are often intersected by other cross fissures, dividing the whole into cuboidal masses, which sometimes decompose still further into spheroidal forms. During this approximation to the calcareous boundary, and whether the laminæ are present or not, the texture becomes gradually finer and softer, the rock still retaining its black colour, or sometimes assuming a greenish cast. At length the observer finds the vein converted under his hand into serpentine, without being at first aware that any change has been brought about. In reviewing it, he traces a regular gradation from the greenstone to the serpentine, in proportion to its approximation to the limestone; and this change is visible, with more or less distinctness, wherever the one substance is in contact with the other, most conspicuous ly, however, and most deeply, where the two are most completely entangled together. The minuter ramifications which branch from the vein into the limestone, are entirely composed of serpentine. It is proper to remark, that no such change is seen in the vein where it is in contact either with the schist or the conglomerate, but that it is entirely limited to the vicinity of the limestone. The zone of serpentine thus described cannot, on account of its gradation into the greenstone, be rigidly defined; but it can scarcely be estimated at more than a foot, and is often limited to six inches in breadth. This serpentine is generally smooth and soft, with an earthy aspect, and a black colour, sometimes verging on green. In some parts it is mottled with red, when it assumes a more compact texture, a greater lustre, and a somewhat conchoidal fracture, being then undistinguishable from that variety which occurs most abundantly at the Lizard point in Cornwall. It is intersected in an irregular manner by thin laminæ of purple, green, and white steatite, generally not exceeding paper in thickness. In some places, however, veins of transparent green steatite, of a quarter of an inch in thickness, and either compact or fibrous, are found in it; and these veins, it must be remarked, never penetrate the greenstone, but terminate somewhere before the change from the one to the other substance is completed. Similar veins of green asbestos, possessing a changeable lustre, are found in it, removing, together with the steatite, all doubt of the character of the substance in which they lie, if any doubt could be entertained after the facts above stated. Although there is great mechanical confusion, with appearances of fracture and displacement, where the trap vein and limestone are in contact, it seems always sufficiently easy to define them; no gradation being any where to be traced between the vein, or rather between its serpentine crust and the calcareous rock. They are indeed amply distinguished by the contrast of their colours, the whiteness of the one, and the blackness of the other. In one part of this contact, however, there is to be found an affinity, or rather a mineralogical gradation, where the distinction of colour still appears to form a marked boundary. This consists in a substance of a steatitical nature, which is found mixed with the limestone, extending, like the serpentine, but a few inches from the line of contact before mentioned. It is often equally difficult, in this case as in the former, to distinguish precisely between the steatite and the limestone with which it is united; a gradation, or else an intimate mixture of the two taking place; while the colours of both being similar, the difficulty of making the distinction is rendered still greater to the eye. The steatitical substance presents the usual ambiguous mixture of indurated steatite and noble serpentine, with a transition between the two, possessing equal claims on each. Small portions of a softer kind accompany it; while the whole, which is readily cut with a knife in its native bed, acquires, on removal and drying, the usual degree of hardness which attends these substances when preserved in cabinets. The colours of this portion of the rock are variously intermingled; and they are reddish, yellowish, pale green, white, and bluish gray. In attending to the chemical composition and mineralogical characters of this steatite, (to use a general term,) and that of the serpentine with which it is in contact, it is evident that there is here a real gradation from limestone to trap, through the intervention of serpentine, however the differences of colour may cause an apparent division. This circumstance is, for aught I know, as novel as it is interesting, and adds one to the many recorded examples of changes existing in rocks where they are traversed by veins of trap, being an occurrence perhaps no less remarkable than that of the gradation of greenstone to serpentine.

Before terminating the description of these rocks, two circumstances respecting the limestone remain to be noticed; they were reserved till the trap vein had been described, since they appear particularly connected with its influence, and are found in its immediate vicinity. In the one, the limestone is so charged with yellow clay, that by degrees it nearly loses the calcareous character, becoming an earthy rock, scarcely distinguishable from some of the claystones that belong to the recent porphyritic formation. In the other, two colours, a purplish brown and a white, are disposed in stripes, contorted together in a most intricate manner, yet still retaining their parallelism, and exactly resembling the effect produced by disturbing a mixture of two tenacious fluids of different colours. It is almost superfluous to allude to the well-known theory respecting the igneous origin of trap, and the equally notorious fact of the fusibility of carbonate of lime, which may be adduced in explanation of this and many other circumstances detailed in the preceding description. I have nothing further to add to the description of these rocks, having discovered no other appearances among them capable of throwing light on their history and origin, or by which they might be connected with rocks of the same nature in other situations.

But it will now be useful to point out the very few analogous facts of the connexion between trap and serpentine, and of the relation of this apparent gradation to the calcareous rocks, that have occurred in my experience. They are scanty, but will, while they confirm the appearance above related, tend to induce others to seek for additional evidence on this subject in places where it probably exists, although yet overlooked.

The numerous trap veins that traverse the hard calcareous sandstone in Strathaird abound in steatite, which here also is found at the outer walls of the vein, where it is in contact with the calcareous substance. A more remarkable resemblance is, however, to be found in a vein that passes through a mass of the white marble of Strath. In this case, the sides of the vein in contact with the limestone pass gradually into serpentine; the whole being, except in point of magnitude, undistinguishable from the appearances already described as occurring at Clunie. At the line of contact also, a zone of transparent serpentine, of a fine oil-green colour, is found intermixed with the limestone, producing those ornamental specimens formerly described in the account of Sky, given in my work on the Western Islands.

These are the most decided analogies that have occurred to me. A feebler one may be found in a circumstance extremely common in the trap rocks. It consists in a coating of steatite, often of a fibrous appearance, and sometimes mistaken for a *slickenside*, or the result of friction, which is found investing veins of calcareous spar; and consequently, as in the former cases, interposed between that substance and the trap.

This fact must be familiar to all geologists; but its value has hitherto been as little understood as its real nature. It is one of many of those insulated remarks which become valuable by being thus generalized and brought to bear on some leading and theoretical view; and, in this case, it served to confirm the still obscure connexion between trap and serpentine.

On reviewing the facts as thus stated, there appear to be many circumstances defying our present means of explanation, both in the characters of the limestone, and in those of the greenstone. The appearances attending the former are indeed less remarkable than the peculiarities of the greenstone; since corresponding, if not identical ones can be traced in other cases. To the most common of these, its irregularity of structure, its detached nature, and the admixture of foreign substances, I need scarcely allude, as they will suggest themselves to all who are familiar with the primary rocks. These irregularities may perhaps in this case be attributed to the disturbing influence of the trap vein; a supposition not unreasonable, since analogous appearances are frequently to be observed in similar cases. I cannot here lay much stress on the cause above noticed, which has been assigned for these phenomena, namely, the fusibility of carbonate of lime, since difficulties of a chemical nature attend this explanation, which, if they are not insuperable, are still, in the present state of our knowledge respecting the affinities of the earths, incapable of a definite answer. I allude to the minerals mixed with it; which the action of fire at present causes to enter with the calcareous earth into new compounds; a difficulty, nevertheless, which the presence of carbonic acid in the one case, and absence in the other, might be sufficient to explain. The proximity of the steatite to the serpentine, which gives the appearance of a gradation between the limestone and the greenstone, might be supposed merely accidental; and, in this view, the difficulties attending this rock would be diminished. But it has been shown to occur in other cases where trap veins are found traversing limestone; a circumstance proving a natural, if not a necessary affinity, between the one phenomenon and the other. In the primary limestone, the occurrence of steatite and of noble serpentine is not unusual; it is to be found in Iona, in Glen Tilt, at Balahulish, in Tiree, in Harris, and in many other places; and in most instances it exists in that part of the calcareous rock which is in contact with the other primary rocks in which it is imbedded, the granite, gneiss, or micaceous schist. Even these analogies render it probable that it is the result of some combination between the different substances at the point of contact, or of some influence of the one rock over the other, concerning which our present information will not allow us to speculate further. Hereafter, it may possibly be elucidated by some of those discoveries which, in the present activity of geological investigation, are occasionally added to the yet limited stock of our knowledge on these subjects.

The geological connexion of the serpentine, both with the trap and the limestone, is still less intelligible. While the very imperfect knowledge we yet possess of the nature and connexions of serpentine, is the source of this difficulty, it renders, at the same time, more valuable, any new fact capable of ultimately throwing light on the history of this rock. As yet, serpentine has, I believe, been found only among the primary rocks. Thus, at least, it exists in this country, in Cornwall, in Anglesea, in Ayrshire, in Forfarshire, in Aberdeenshire; at Portsoy, in Sutherland, in Shetland, and in the island of Scalpa; the only situations in which I am practically acquainted with it. In some of these places, where it is associated with gneiss, it forms obscure strata, as far as their forms are concerned, though the stratification can admit of no question. In others, the beds are limited, or resemble rather large concretions, conformable, as far as they reach, to the rock in which they lie; and very similar in this respect to the independent masses of limestone so often found in the same rock. In other cases, as where it occurs in granite, it appears more akin to the unstratified substances, being analogous in position to the more ancient or the more recent formations of trap or porphyry; and possibly, like both, appertaining to very different periods. In this manner, in particular, it occurs in Aberdeenshire. If, in those latter instances, it is really an unstratified rock, and analogous to the trap formation, it may possibly be found, as the rocks of this division are, associated with the secondary as well as with the primary strata; a situation in which, as far as I know, it may indeed have already been discovered. Even in this case, it must, however, be considered as secondary, only in the same way as trap is; not as a deposit regularly alternating with the strata, but produced under circumstances unconnected with their original stratification, concerning which we can do little more than conjecture. In support of this opinion, there is at present no evidence to adduce beyond the few facts already mentioned. It is easy to imagine that veins of serpentine might exist, passing, like the compound one of Clunie, indiscriminately through the primary and secondary strata; since there is no sufficient reason why the serpentine, in the instance now described, should not predominate, to the exclusion of the trap, in the larger vein, as it does in the smaller ramifications.

The conjectures thus offered may be entirely unfounded; but they will still be useful in directing the attention of geologists to these obscure rocks, and in affording hints towards a method of investigating them; while, at the same time, they will give the stimulus, so often advantageously presented by any hypothesis capable of directing our attention to some focal point.

But one circumstance more remains to be noticed: it is the nature of the mineralogical connexion between the greenstone and the serpentine. There can be no doubt of the gradation between the two, nor of the perfect character of each substance, at the extreme points of both. As far as composition is concerned, it is known that hornblende is an ingredient in both rocks; but there are still essential differences, as well in their chemical nature as in their mineral composition. We are as yet incompetent to explain the nature or cause of this transition; though the mere circumstance of such a transition is sufficient to prove an affinity between the two. That which occurs on a small scale is equally possible on a large one; and there is no difficulty in conceiving the existence of a mountain composed both of trap and serpentine, passing into each other, and mutually connected in a common geological relation. On a very superficial examination of the serpentine of Cornwall, made many years ago, without any geological object, some facts occurred which may perhaps throw additional light on the connexion between that rock and trap; but the recollection of them is now too indistinct to permit of any detail. A careful investigation of the Lizard Point, and of the shores contiguous with it, is recommended to those geologists whose local situation or pursuits give them access to this part of Cornwall.

The limitation of the serpentine to a short distance from the limestone, might at first sight give cause to suppose that the greenstone had been converted into that substance by the influence of the calcareous rock, or by some combination between the two. But this supposition is not confirmed by any thing we know of the respective compositions of these different substances. At present it must remain, among other difficulties, a prize held out to the more successful efforts of some geologist who may follow me in this obscure track.

POSTSCRIPT.

It is long since the above paper was written; and though I have kept it by me in hopes of additional information, very little has occurred to elucidate the different points discussed in it. The publication of it will perhaps induce those geologists who may have an opportunity, to turn their attention to this almost unknown subject, and to lend their assistance in explaining the present very obscure history of serpentine.

Yet the original hints, to the same effect, thrown out in the description of Sky, in my work on the Western Islands, have been noticed, and these views confirmed by Breislak, where he quotes some parallel remarks on the same subject, made in the Bosphorus by Vivian. In this case, a similar transition from trap to serpentine has been traced. Possibly other analogous observations may be known to those who are conversant with the recent writings of foreign authors, and who have not, like me, been lately cut off from all means of information. I must trust that they will thus be induced to bring them forward, and also to give their own aid in completing, by further observations, a work from which I am in future for ever debarred.

I have added a Figure, (see Plate I. Figs. 1 and 2.) for the purpose of rendering the description of these appearances more intelligible. The explanations on the figures themselves will supersede the necessity of any other details in this place.

ART. II.—*Account of a Journey to Monte Rosa, and of the first Ascent of its Southern Summit.* By JOSEPH ZUMSTEIN and JOHN NICOLAS VINCENT.*

MONTE ROSA, from which many other mountains branch out, is terminated by several aiguilles, which are always covered with snow and with ice. These peaks form a sort of crown round this grand amphitheatre, which may be compared to a sea of ice. Saussure himself believed it impossible to reach it, and even to the present hour nobody has attempted to gain the summit of this celebrated mountain.

Accustomed from early life to ascend mountains, I formed a project, in concert with my friend M. Vincent, of examining these high glacial masses; and after providing ourselves with barometrical and trigonometrical instruments, and all the usual implements and utensils, we were ready for the undertaking.

On the 4th of August 1819, M. Vincent ascended with the loaded mules to the central cabin, at the confines of perpetual snow. The road being now impassable by mules, the instruments were carried by miners to the upper cabin, about a league above the ordinary confines of the icy region, and he here spent the night with his attendants. On the 5th of August, early in the morning, he took with him two men, and a skilful Chamois-hunter, for the purpose of erecting a wooden cross on the summit of the aiguille. After traversing immense plains of snow, exposed to great sufferings and dangers, they reached the talus, which forms the base of the aiguille, and they succeeded in gaining its summit at 11 o'clock in the morning. Here they were surrounded on all sides with a thick fog, but they lost no time in marking their arrival, by fixing the cross at the depth of six feet in the snow. After resting half an hour, they descended with much difficulty, and reached the bottom exhausted with fatigue.

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* This Journey was performed in August 1819. An account of it was read to the Royal Academy of Turin in June 1820, and published in the *Memorie della Reale Accademia di Torino, tom.* XXV. p. 230, from which we have translated and abridged the following Narrative.—ED.

On the 10th of August, M. Bernfaller, canon of the Hospice of Great St. Bernard, accompanied with a mountaineer, set out in the evening, by moonlight, and following the path of M. Vincent, he reached the summit at 8 o'clock in the morning. From the serenity of the sky, the view which he enjoyed, was of the most superb kind, while a sea of fog undulated under his feet, and covered the surface of the earth, as far as the eye could reach. The loftiest summits of Monte Rosa, and those of the surrounding mountains, were the only objects that rose in insulated forms out of this sea of mist.

On the 11th of the same month, M. Vincent and I set out at three o'clock, P.M. accompanied with a skilful hunter; we ascended the valley by the Trinité Urssieu and Boedemié, the last hamlets that can be inhabited during winter, and reached the place called Rigga. Here we cease to see the Meleze, and above this the rhododendron rarely takes root, and still more rarely the juniper.

Passing over verdant hills, covered with the debris of rocks, detached and rolled down from the mountains, (which are called *Gofer* in the country,) our path conducted us to a small height, where we were charmed with the view of the mountains of Gabiet, which we reached at five o'clock, after passing the place called Nidelgasse. Having refreshed ourselves at this place with a little milk, we pursued our route across green pastures towards the river of Lafets.

The fine cascade which appeared on our left, and the Alps of Lafets in perspective, presented a very delightful view. This cascade may be regarded as one of the finest, next to that of the Rhine, and that of Tousa in the valley of Pomat, especially if we see it in June, when from the melting of the snows, it exhibits all its magnificence. Advancing by the right of the cataract, we come to the mountains of Indren, which appears like a kind of basin. Here are established the mills for the mines belonging to M. Vincent; and at this height there grow only a few wild herbs that exhale a very strong odour.

After a few minutes rest we ascended various eminences, and reached the second barrack of the miners, at the distance of a league from the mills, and where the region of the glaciers begins. Immediately behind this cabin commences the first perpetual snow, over which we walked more than an hour, and arrived for the night at the last barrack of M. Vincent's workmen.

According to Daubuisson and others, this cabin, which is only inhabited two months in the year, is the highest in Europe. It is situated on a branch stretching from the central mass of Monte Rosa, and it separates the great glacier of Indren from that of Embours. The cabin is placed on a rock, almost vertical, and its entrance can only be reached by a path two feet in width. Here the barometer stood at 19 inches 6 lines, and the thermometer at 14° of Reaumur, which, according to Lindenau's tables, corresponds to a height of 10,086 Paris feet, or 1681 toises.

At the foot of this declivity, on the side of Embours, are situated the galleries of the mines, to which we descend by a zig-zag path cut in the rock.

Here we passed the night, under a mild temperature and a serene sky, but I experienced a decided oppression on the chest, which prevented me from closing my eyes the whole night. At break of day we rose, and, strengthened by a little soup, we continued our course; M. Vincent and the guides having their eyes covered with crape, while mine were defended by spectacles with blue lenses.

Thus equipped, we reached the *Glaciers,* properly so called, at the distance of only twenty steps behind our barrack. The air was loaded with vapours; but we still cherished the expectation of a fine day. As soon as we arrived at the first plane of the glacier of Indren, which unites itself towards the S.W. of the glacier of Garstlets, we perceived towards the W.N.W. the first rays of the sun which gilded the majestic summits of Mont Blanc, Mont Velant, and Mont Cervin, and the further summit of Monte Rosa, which formed the object of our labour. This was a view of which no pen can even trace the outline.

We advanced for several hours over these plains of ice, which resembled the waves of the sea, without being stopped by icy crevices, partly from the massy surface being so solid as to support us, and even serve as a bridge over the precipices, and partly from our keeping to the right, as the least dangerous side of the mountainous declivity, near the places where the glacier of Embours commences towards the N.E. From this Glacier there stretches out one of the branches of the Sesia. Proceeding a few hundred yards farther on the crest of the rock, and being greatly fatigued, we refreshed ourselves for a while with a few drops of Madeira.

I here observed the barometer, which indicated a height of 11,256 feet above the level of the sea. We could with difficulty see upon the rocks some lichens, and some umbilicariæ, all other vegetation having ceased.

The bare and arid stone showed itself from time to time, and even upon this the eye delights to repose, when exhausted with the brightness of the snow. Having rested here another half hour, we pursued our journey over the icy ridges, which became more and more rugged as we advanced; and we were often obliged to stop for breath, particularly when we encountered large crevices marked out by long blue lines, and which we were obliged to ascend by winding round their extremities.

Frequently were we obliged to trust ourselves upon bridges of snow, the strength of which we had no means of ascertaining; and, drenched with perspiration, we continued to ascend, seldom discovering the tracks of those who had preceded us. The horizon now began to be overcast. From the bosom of the valley there ascended, in all directions, thick vapours, which excited great alarm respecting our return. The fine view which we had enjoyed disappeared, and the azure sky showed itself only through the small openings between the clouds. We had still before us another declivity, before we reached the base of the aiguille. We passed with rapidity below an enormous wall of ice, having the form of a canopy, and threatening to overwhelm us. Our alarm on this occasion was not without reason, for I saw the tremendous mass fall on the following day, with a crash like the loudest thunder; and, in the month of September, from the observatory of Turin, I was able to distinguish, with a good telescope, the scattered fragments of this icy wall.

Not far from this place M. Vincent felt a tendency to faint; but it soon left him, and having succeeded in surmounting this last crest of ice, it only remained for us to ascend the aiguille itself. To the right, and below a rock almost perpendicular, and at the depth of nearly 150 toises, (300 yards,) we saw the great glacier of Alagna, intersected with crevices; and to the left we had a snowy declivity, which gradually rose to form above, the point which we were anxious to reach.

Towards its base, this same declivity was extended by an enormous crevice from eight to twelve yards at its mean width, and nearly 200 yards long, and which is capable of being seen from the observatory of Turin. Its sides were of a bluish-gray tint, and at an immense depth there was seen an enormous quantity of water. In the middle of these two horrible precipices, the crest which I have mentioned, or one of the angles of this species of pyramid, upon which we were, leading us often astray to the more dangerous abyss on the right, was the road by which alone we could ascend to the summit of the aiguille. We had, therefore, no choice. After some minutes rest, the boldest of our party, a miner, advanced with a hatchet in his hand to cut out holes for our feet. The hunter followed, to remove with his shovel the debris of the ice. M. Vincent marched next, while I brought up the rear. The steps were formed on the declivity of this tortuous ascent, and upon this, the body being inclined one half, we were almost suspended. We grasped firmly with our right arm the margin of the abyss towards the glacier of Alagna, and, from the bent position into which we were thrown, often only a single point of our feet was supported on the steps. Surrounded with so many difficulties and perils, we advanced with the greatest precautions; for the least false step would infallibly have precipitated us on the right or on the left. We aided ourselves with an iron pointed staff as often as this was possible, and thus slowly reached the half-way point of the crest, keeping always to the left, when the sight of a projecting rock, on which we might take a little rest in safety, began to delight us at a distance. We continued for some time quiet at our post, in order to give time to the miner to continue his work, when, all on a sudden we saw the hunter grow pale, and support himself in a tottering position on the declivity at his left. M. Vincent, who was nearest him, was alone able to give him assistance; for the miner, who was before the hunter, was unable to go backwards, while I durst not quit my position for fear of slipping down. M. Vincent, therefore, with much presence of mind, took a handful of snow, and rubbed with it several times the forehead and temples of the poor hunter. This application was so successful at this critical juncture, that we had no occasion to have recourse to the spirituous liquors, which the hunter himself carried on his back.

This accident, which might have proved very alarming to us all, caused us to forget our own danger; for we were scarcely at our ease, and our safety depended solely on the strength of our joints. During this crisis, the miner carried on his work till he reached the projecting rock above mentioned, which we were gradually approaching with slowness and circumspection. We at last reached it, and it was fortunate that we did; for we had great need of rest. Our small provisions were now displayed, consisting of bread and cheese, cold meat, onions, and wines, which contributed to renew our strength so easily re-established in elevated regions.

It was now half-past eleven, and we had still half a league to march. A proposal was now made to tie us all together with the same cord; but I resisted this measure, as the slipping of a single foot might have dragged us all together into the abyss.

Our first guide again set out to excavate new steps with his hatchet, and we soon came up with him by an ascent that became more and more rugged. The brink of the snow began to grow wider, and, after fifty steps of less difficult ascent, we at last reached the summit of the Needle. It was now past 10 o'clock, and the road which we had formed, by cutting more than 600 steps in the ice, had cost us three hours of difficult and laborious exertion.

The summit on which we now stood was about six yards in diameter. The triangular space which it forms is rounded towards the south. It has a very steep declivity to the S.E, and the form of a half moon towards the N.N.E.

It is from this last point that there sets out a particular and uninterrupted chain of mountains, which stretch to the plains of Canavais, and terminate with the Serre near Cigliano, The view which was now presented to us of this basin, surrounded with these immense glaciers, and studded on its margin with five large aiguilles, and many of smaller size, was in itself truly unique.

This part of the landscape alone was illuminated by a perfectly serene sky, whilst the rest of the horizon, which extended far over Piedmont and Lombardy, was obscured by clouds, and deprived us of one of the finest views which could be seen. A single opening in the clouds permitted us to see the valley of Lys, which we had great difficulty in recognising. It appeared like an obscure cleft of a rock, which the Lys, like a thread of silver, traversed with its serpentine stream. The atmosphere around us was entirely free of vapours; and the cyanometer of Saussure indicated the intensity of the blue colour of the sky to be from 38° to 40°.

The sound of the voice appeared to be less here than elsewhere, owing, no doubt, to the air being scarcely fitted by its rarity for the propagation of sound. A perfect silence reigned around us, and a gentle zephyr scarcely breathed from the S.W. and the N.E. As soon as we had recovered from the agitation and fatigue of our journey, I felt my own pulse and also that of the others. M. Vincent's was 80 in the minute, mine was 101, that of the hunter 77, and that of the miner 104.

The barometer and thermometer remained steady at the same point, from half-past one to half-past three o'clock, as follows:

Barometer . . .	16 inches 10 lines.
Attached thermometer .	12° Reaumur.
Detached thermometer .	8¼° do.

On the same day, at the observatory of Turin, the following observations were made:

Barometer . . .	27 inches 3 lines.
Thermometer	25°.4.
Thermometer towards the north	24°.

According to the Tables of M. de Lindenau, these observations give a height of 2820 toises, or 18,920 feet above the level of the sea.

We were very little disposed to eat, but we were all very thirsty. We made a moderate repast, and drank a little of the Alkermes to the health of the celebrated naturalists De Saussure and Alexander Humboldt.

I remarked upon the snow some silvered butterflies, having some resemblance to our common butterflies, of a pearly hue. In stooping to catch some of these little insects, I experienced a considerable giddiness, which went off as soon as I recovered the erect position.

I now began my trigonometrical observations, and measured the altitude of three of the principal aiguilles, which I have already mentioned, by means of a compass divided into 360°, which was skilfully adjusted to a level, and a telescope, as well as a semicircle also divided into the same number of degrees. From these observations I obtained the following heights above our positions:

	Feet.
The first *aiguille*, towards the N. E. of our position, and which rose from the glacier of Alagna, was	560
The second point, of a mammillated form, and which rose by steps from the great glacier of Lys, between the N. W. and N. N. W. - -	1200
The third, and the most remote, as well as the highest, rose towards the N. N. E. almost perpendicularly, from the bottom of the glacier of Macugnaga,	1680

But, as the absolute height of our position was 13,920 Paris feet, it follows that the highest summit of Monte Rosa is 15,600 Paris feet above the level of the sea.

It must be admitted, that, in this determination, there is some imperfection; but it cannot be doubted, *that the highest point of Monte Rosa exceeds considerably that of Mont Blanc,* and that we can no longer dispute its claim to be the highest mountain in Europe, since Mont Blanc, according to Professor Tralles, is only 14,798 Paris feet above the level of the sea.

As it was now four o'clock, our stay could not be prolonged with safety, and we accordingly set out on our descent, in the same order in which we came, and by the same steps. About 100 paces from the place where the descent was not very steep, I detached some fragments of a rock, which appeared to be what is called aventurine, with quartzy and red micaceous scales.

We had no sooner begun our descent along the icy declivity, than we saw with terror that the sun had softened the snow with which the ice was covered. This was the greatest disaster which could have occurred to us; and, in such circumstances, good advice would have been invaluable; for our lives were so evidently in danger, that we were on the point of despairing of our return. It became necessary to re-cut, in a great degree, the steps which we had excavated in the morning; and we thus advanced with infinite difficulty, taking care at each step to drive into the ice the spikes which we had upon our shoes.

At this time there was displayed, in all its horror, the frightful abyss which opened at our side, and we were obliged to turn our eyes from the scene as much as we could. The slightest blast of wind would have precipitated us with as much facility as it would have carried off the slenderest leaf. With every precaution, therefore, we slid in trepidation along this dangerous crest, to the commencement of the large crevice which was formerly mentioned, and where the glacier assumed at last a more rounded form. The greatest dangers were now past; and, extended on the snow, we recruited ourselves by our spirituous liquors. The two workmen emptied, at a few draughts, a bottle of Jamaica rum, while M. Vincent and I preferred a little of the Madeira, which still remained. The repast which we then made was the most delicious we had ever enjoyed, and we returned thanks to Providence on finding ourselves out of the dangers to which we had just been exposed. After half an hour's repose, we tied ourselves to one another, at the distance of twenty paces, by means of a very long cord, for on this occasion I approved of the scheme, and we marched gaily forward, with the snow sometimes up to our knees. In order to shorten our road, we often slid down steep declivities, always tied to one another, and without taking much care of the crevices which might have crossed our path, being rather heedless of smaller dangers, after the great ones which we had survived.

In this state of confidence, when we were all sliding down a declivity, the one being drawn by the other, the first upon the cord arrived at a crevice. The snow which covered it sunk down all on a sudden, and the poor man fell backwards into the crevice. M. Vincent, who followed him with his eye, had the presence of mind to strike his iron-pointed baton against the sides of the ice, and by this quick manœuvre he prevented us from tumbling, one over another, into the crevice. The man who had fallen in, did his best to extricate himself from the crevice, and by our assistance he was brought out with no other injury than a little fright, which rendered us all more circumspect in future.

In our progress we heard, more than once, both from our right and left, loud noises, similar to claps of thunder, which were produced by the fall of great masses of ice, or avalanches of snow, which the heat of the day had detached.

Exhausted with fatigue, and drenched with perspiration, we arrived, towards the evening, at the same barrack from which we had set out in the morning, and, with a good fire, and a little nutritive soup, we spent the night in tranquillity. On the next day, the 13th of August, our eyes began to smart, as well as the skin of our faces, and some days afterwards it peeled off, and slightly disfigured us.

The chain of Monte Rosa, which we passed over towards the south, appeared to be composed of alternate beds of gneiss and grained granite. From Gressoney, on the left of the Lys, to Urssieu, and even to the cow stations of Gabiet, calcareous rock and common serpentine prevailed.

On the right, towards the Pass of Olen, we found foliated, or scaly serpentine, and an ore of iron; and some paces higher I found the radiating asbestos, and epidote containing small garnets. We afterwards met, in several places, the debris of granite, in efflorescence, of a reddish brown colour, between the beds of which there occurred a very compact ore of antimony. Towards the top, and about a league beyond the commencement of the icy region, we find the gold mine of M. Vincent, within the veined granite, mixed with milky quartz. The veins of this mine stretch from S.W. to N.E. and are placed almost vertically, like the primitive rock. The gneiss and the quartzy vein accompany one another almost invariably, even to the summit of the mountain.

Thus terminated an excursion to the glaciers, more happily than we had reason to expect. If Providence still give us health, and a favourable opportunity, we propose, in another journey, to go to the centre of the crown formed by the aiguilles of Monte Rosa, for the purpose of ascertaining correctly its figure and height, and of examining, at this prodigious elevation, the phenomena of light, heat, and of the boiling point of water. Our efforts will be particularly directed to effect the ascent of the highest point of Monte Rosa; and we venture to say, that we want neither the courage nor the bodily strength which this ascent requires.

ART. III. *On the Astronomical Observations made at Dorpat*, by M. STRUVE.

THE new university of Dorpat, in Livonia, established by the Emperor of Russia, possesses an observatory, that, from the instruments with which it has been furnished, and from the zeal and ability of the Professor, M. Struve, is likely to take a distinguished place among those of Europe.

Three volumes of Observations have been already published, of which two have only recently reached this country. A short account of these will, we conceive, be not uninteresting to our astronomical readers. We have already given, in considerable detail, M. Struve's valuable observations on double stars, which are also contained in these volumes, and shall here principally confine ourselves to his observations with the transit instrument. He possessed no good instrument for observing declinations at the time he made these observations. He has since acquired one of Reichenbach's three-feet circles.

The transit observations will probably bear an advantageous comparison with any transit observations that have ever been made, both from the ingenuity and skill by which M. Struve got rid of the usual sources of error in his instrument, and from the exactness of his results, relative to some of the most delicate inquiries of astronomy.

The transit instrument was made by Mr. Dollond, is eight feet in length, and the axis is four feet. The aperture of the object glass exceeds four inches. Mr. Struve speaks very highly of the optical powers of his instrument. He mentions that he has been able to observe the small star of the eleventh magnitude 18′ from the pole star, when the wires were considerably illuminated;—that he has also been able to observe it when the twilight was so strong that the wires did not require illumination;—that he has observed several stars of the third magnitude, when the sun was near the meridian; and that he has even observed θ Cassiop. a star of the fourth magnitude, when on the meridian with the sun.

At first, he had only five wires in the focus; afterwards he inserted seven. His clock appears to have been a good one; but, from the manner in which he has ordered his most delicate observations, he was able to avoid any dependence on the going of the clock for more than a very short space, often for only a few minutes.

He principally applied himself to observations of circumpolar stars. The reasons he assigns for thus confining himself are, that these stars have been less accurately observed by other astronomers; that, in stars near the pole, where both culminations could be observed, he could apply his observations to the investigation of the aberration of light, and the parallaxes of the stars. The skies of Dorpat appear to be particularly favourable to observations of this kind, for M. Struve mentions it seldom happened that he was unable to make an observation of the pole star.

He states, with the utmost minuteness, the steps he took to insure accuracy; and it will be necessary, before we refer to his results relative to parallax and aberration, to relate very briefly some of these. The formulæ by which the errors of a transit instrument may be corrected or allowed for are to be found in Delambre, Bessel, &c. but they appear to have been more used and more strictly attended to by M. Struve than by other astronomers. Indeed this was required by many of his observations.

The three adjustments of a transit instrument are,

1. To make the line of collimation perpendicular to the axis.

2. To make the axis level.

3. To adjust the instrument to the meridian.

The effects of the errors arising from the want of these three adjustments are expressed by

$+ a \sin. z \sec. d + b \cos. z \sec. d + c \sec. d$ above the pole.
and $+ a \sin. z' \sec. d - b \cos. z' \sec. d - c \sec. d$ below the pole.
where $15\,a$ expresses the deviation from the meridian,
$15\,b$ expresses the deviation from the zenith,
and $15\,c$ the error of collimation.
z is the zenith distance above the pole, z' the zenith distance below the pole, and d the declination.

But these expressions may, as is well known, be put into a more convenient form, and are so used by M. Struve.

$$m \pm n \tan. d \pm c \sec. d$$

where $m = a \sin. \text{lat.} + b \cos. \text{lat.}$ . . . . . . (p)
$n = -a \cos. \text{lat.} + b \sin. \text{lat.}$ . . . . . (q)

Or, according to his way of considering it, if we conceive a plane at right angles to the axis, this plane will intersect the equator in a certain point, and the angle contained by the circle of declination passing through this point and the plane will be measured by $15\,n$. This is called the *deviation* of the instrument *from the pole*.

The transit of a circumpolar star being observed above the pole at the time T, the true time of transit is $T + m + n \tan. d + c \sec. d$, and the time of transit below the pole being T', the true time is $T' + m - n \tan. d - c \sec. d$. Hence the diff. $= T' - T - 2\,n \tan. d - 2\,c \sec. d = 12$ hours. Therefore, if $T' - T$ be exactly known from the rate of the clock, and if we know c, we obtain from this equation the value of n.

Consequently, when the difference of right ascensions is only wanted, we know the correction $\pm n \tan. d \pm c \sec. d$, and then it is not necessary to know exactly the position of the instrument with respect to the planes of the meridian and horizon. By using a second star, we need not depend on the going of the clock for twelve hours, as will be seen presently, but only for a few minutes. This circumstance is of much importance.

But, if we desire to have the quantity m, we must then know both a and b. a cannot be determined conveniently, unless by astronomical means, but b can be determined by a level or plumb line; and b being known, a is determined from the equation (q), and then m from the equation (p).

M. Struve gives, for each day's observations, in his second and third columns, the values of m, n, and c, and gives also the corrections thence arising for each star. He gives, in much detail, the investigations for determining m, n, and c. To show the exactness he aims at, it may be mentioned, that latterly he has modified the values of n and c, so that the effect of the diurnal aberration is done away.

He gives, in each volume, a detail of his investigations for the values of $15c$ and $15n$. The error of collimation $15c$ is not liable to much change. M. Struve generally determined it by reversing. But $15n$, the deviation of the instrument from the pole, is liable to greater variation, arising both from the variation of the instrument in azimuth, or from the meridian, and from changes in the inclination of the horizontal axis. The permanency of the quantity $15n$ is therefore the criterion of the steadiness of the instrument; and were the difference of right ascension only required, the value of $15n$ needs only be sought for. It is of no consequence to distinguish the effects of the error of the axis, or of the deviation from the meridian. But when the right ascension itself is required, it is necessary to determine m, and therefore to separate the two errors from which $15n$ arises.

In the first volume of his Observations, M. Struve did not separate these errors by either levelling the axis or adjusting to the meridian, as his object was only to ascertain the relative right ascensions of the circumpolar stars, by referring them to fundamental ones. In the second and third volumes, however, he separates these errors, by using a spirit level for determining the inclination of the axis, and therefore he is enabled to determine m, and consequently to obtain the absolute right ascensions.

He appears to have very rarely adjusted his instrument to the meridian, but left the error to be determined by observations, in assigning a just value to $15n$. This method, which is more used on the Continent than here, possesses several advantages, easily appreciated by the practical astronomer.

The tables of the values of $15n$, in the several volumes, principally determined by the pole star, but occasionally by two stars nearly opposite, in right ascensions, afford an interesting history of the instrument. Periods will be found in which the steadiness of the instrument is very remarkable

At other times, sudden and considerable changes took place. Respecting the causes of these, M. Struve offers several conjectures. Very severe cold seems to have had a great effect, not acting suddenly but slowly. The melting of the snow in spring seems to have been attended with great derangements in the position of the instrument, in consequence, as M. Struve supposes, of the vast quantity of water suddenly passing into the earth.

M. Struve satisfied himself that there was no *daily* periodical change of position, a circumstance, as he observes, much to be feared, especially when the observations are applied to the investigation of parallax and aberration.

Our author appears to have been unwearied in his endeavours to search out the minutest sources of error in his instrument. After four or five years observation, he discovered a very unexpected circumstance. He found that the error of collimation was different at different distances from the zenith; that when the error was $=0$ in the horizon, it was $4''$ of a degree in the zenith. His investigations relative to this matter appear to deserve great attention. He gives formulæ for the corrections arising on this account, both for correcting his preceding, and for applying it to his future observations. He also assigns the reason why this variable error of collimation escaped him before, and shows the small effects of it in the most important of his observations. The cause of it does not distinctly appear. He attributes it to flexure either in the tube or axis, or both. The subject itself demands the attention of astronomers.

Fortunately, in the results of M. Struve that are most particularly deserving of notice, and in which he seems to have arrived at even a greater exactness of observation by the transit instrument than has been attained to in the zenith distances, we have little to do with the accurate determination of the errors of the instrument. The effects of any uncertainty in the values of m, n, or M, N, by which latter letters M. Struve denotes the former, corrected for the variable error in collimation, have no influence. All that is required is, that the instrument should not change its error during the 24 hours; and perhaps a transit instrument in this respect may, from the manner in which it is mounted, be less liable than other instruments to be deranged by the variations of temperature.

M. Struve's application of the transit instrument to the investigation of the sum of the parallaxes of two opposite stars, and to the investigation of the constant of aberration, is as follows:

Let A and B be two circumpolar stars, *both* culminations of *each* being supposed *visible* at *opposite* seasons.

$T+e$ = the time of culmination of the star A above the pole.

$t+12^{h}+e'$ = the time of culmination of the same star below the pole.

$T'+e''$, $t'+12^{h}+e'''$, the same quantities relative to the star B.

e, e', e'', e''', are the errors of the clock.

Then because n tan. d, and e sec. d, have different signs above and below the pole,

$$\text{the right ascension of A} = \frac{T+t+t+e'}{2}+m,$$

$$\text{the right ascension of B} = \frac{T'+t'+e''+e'''}{2}+m.$$

Therefore

$$\text{the diff. of right asc.} = \frac{(T-t')+(e-e'')}{2} - \frac{(t-T')+e'-e''}{2}$$

The determination of the difference of right ascension is therefore independent of the errors of the instrument, and depends only on the accuracy of the observations, and the exact knowledge of the rate of going of the clock during the short times $T-t'$ and $t-T$, often of only a few minutes.

This difference of right ascension of two opposite stars being affected by refraction and parallax, we obtain for each determination an equation of this form:

$$C+r\overset{u}{c}+s\,a+v\,\pi+w\,\pi'=0,$$

where C, r, s, v, and w, are known quantities, and C = the correction of the tabular diff. of right ascension.

$20'',255+a$ = constant of aberration,

and π and π' = the constants of parallax.

The circumstance of the two stars being nearly opposite in right ascension, enables us to express the two terms $v\,\pi+w\,\pi'$ by one term b' P, v' being known. This abridges considerably the computation. The sums of the squares of the left hand side of the equations being made a minimum, the values of C, a, and P, are obtained, and then $\varpi + \frac{w\varpi'}{v} = \frac{P}{v}$.

As stars nearly opposite in right ascension, that can be seen at both culminations, are required, the number is very limited to which this method can be applied.

M. Struve gives us the following results of all his observations for aberration.

No. of Observ.	Pairs of Stars	Constant of Aber.
183	Polaris and ι Ursæ Maj.	20″,346
122	α Cassiop. and ι Ursæ Maj.	20″,351
95	δ Cassiop. and ζ Ursæ Maj.	20″,240
112	β Ursæ Min. and α Persei.	20″,439
107	Capella and β Draconis.	20″,421
74	β Aurigæ and γ Draconis.	20″,277

From whence he concludes the mean constant = 20″,349, the probable error being 0″,013.

He deduces also, as a conclusion, that there is no reason, from these observations, to suppose a difference in the constants of aberration in any of these stars, amounting to one-tenth of a second. "Has observationes nullam nobis offerre causam, cur suspicemur, inter harum undecim stellarum aberrationes interesse differentiam constantem, quæ 0″,1 arcus attingat; sed eo nos potius ducere, ut ratum habeamus in his stellis aberrationes numerum esse eundem, quam proxime = 20″,349, vel 20″,35."

He next gives the results of his observations for examining whether there may not be some difference with respect to the aberration of a bright star, and a small star near it. The stars he examined were ζ Ursæ Maj. and three stars near it, one of which was Alcor, of the fifth magnitude; α Cassiopeæ, and its attendant, of the ninth or tenth magnitude; the pole star, and the small star of the eleventh magnitude. He found no difference as to the aberrations of ζ Ursæ Maj. and the three stars, nor as to α Cassiopeæ and its small star. But he considers it otherwise with respect to the pole star and its attendant. It appears to him, that the aberration of the lesser star is less than that of Polaris. "Concludamus itaque: discrimina inter aberrationes stellarum, si quæ sunt, esse valde exigua in pluribus stellis, ut probabile 0″,1 arcus minora, sed ex observationibus sequi, pro Polari (2*m*) α comite (11*m*) tale discrimen, inter 0″,1 et 0″,2 arcus, locum habere."

In the investigations for parallax, stars of fainter light can be used in M. Struve's observations than for aberration, because in the times of greatest parallax they culminate about six hours from noon; whereas at the time of greatest aberration they culminate near noon. Accordingly, he has been able to examine 27 stars in pairs. But in all cases *except one* he has found the sum of the two parallaxes so small, his results being some positive and some negative, that they may be considered as insensible. In that one case, however, viz. for α Cygni and ι Ursæ Majoris, he finds it =0″ 434. He had found it something more in his second volume, and there speaks of it doubtfully, but as deserving of farther inquiry. In the third volume he considers the above result as possessing great weight. He observes, "Huic vero maximæ parallaxium summæ ad stellas α Cygni et ι Ursæ Maj. pertinenti magna fides videtur habenda esse," &c. He then proceeds to give several reasons for this confidence; and he concludes, "Dignæ utique sunt hæ stellæ quæ diutius hac ratione observentur, ut fides, quæ etiamnum non exigua videtur, crescat."

Now, it must be considered a remarkable coincidence, that Dr. Brinkley, by observations of zenith distances with the Dublin circle, makes by 228 observations the parallax of α Cygni =0″46, (see his paper on solar nutation,) and although the above is the sum of the parallaxes, there is no reason for assigning a visible parallax to ι Ursæ Maj. (4*m*) to disturb the coincidence of the Dublin and Dorpat results in this respect. M. Walbeck, indeed, supposes in M. Struve's second volume that ι Ursæ Maj. may have the greater parallax of the two; but this supposition, founded on the circumstance of ι Ursæ Maj. having a considerable proper motion, rests on a very slight support. Thus, in the only instance where a comparison could be made between the observations of M. Struve and Dr. Brinkley, relative to the *quantity* of parallax, they are found to agree. They also agree in finding no sensible parallax in Polaris and in γ Draconis, of both of which stars Dr. Brinkley has made observations so numerous, that the non-existence of a sensible parallax in these two stars appears to be placed beyond doubt.

But it is not only with respect to the parallax that the Dublin and Dorpat observations agree. Dr. Brinkley, (*Phil. Trans.* 1821,) by a mean from several stars, finds the constant of aberration =20″.37. He finds (in his paper on solar nutation) for *α* Cygni the constant =20″.33, and for *α* Lyræ 20″.25. This extraordinary coincidence in results, obtained by methods so entirely different as the Dublin and Dorpat observations, appears well worthy the attention of astronomers, and places in a strong light the perfection of modern instruments, and the accuracy of modern observations.

M. Struve proposes to extend his observations for parallax to several other stars, of which he has given a list. Several of these are of the fourth magnitude; but he hopes for success in making the observations, from the favourable time of day of culmination, when the parallax in right ascension is a maximum. *α* Lyræ is also among those stars; but there appears to be no circumpolar star nearly opposite in right ascension, greater than between the fourth and fifth magnitudes. M. Struve's future observations will greatly interest astronomers. A vast field is still open to him; and one almost feels sorry that any other pursuit should divert him from the transit instrument, with which he has made such accurate and important observations. We must, however, expect that the circle of Reichenbach, which he had just received when he published his third volume, will share a good deal of his attention.

Art. IV.—*An Account of the Janji, or Valisneria Alternifolia of* Dr. Roxburgh, *the plant used in India in refining sugar, by* Francis Hamilton, M. D. F. R. S. and F. A. S. Lond. and Edinb. &c. Communicated by the Author.

It is well known that one of the most common processes for refining sugar is by filtering water slowly through small quantities of it, contained in pots, with an aperture in the bottom. The water carries along with it the extractive matter, and the minute saccharine particles united with it, which constitute what is called treacle; and leaves behind the more pure crystalline sugar. In our West Indian islands the water is supplied by a cake of moist clay placed on the surface of the sugar; but in India it is supplied by covering the upper surface with a layer of moist aquatic plants.

The plant selected is commonly that, which in the Hindostan language is called *Janji*, and which Dr. Roxburgh, in his manuscript, called *Valisneria alternifolia*; although I doubt much the propriety of placing it in that genus. A similar plant, indeed, by the younger Linnæus was called *Serpicula verticillata*, and was described by Dr. Roxburgh under this name; although Willdenow had called it *Hottonia serrata*. The latter botanist, however, having found out that his *Hottonia serrata* was the *Serpicula verticillata*, adopted this name. Before his death, Dr. Roxburgh became sensible that the plant was neither a *Serpicula* nor a *Hottonia*, and that it belonged to the same genus with the *Janji*, which he called a *Valisneria*. In the catalogue of the plants in the Botanical Garden at Calcutta, the *Serpicula verticillata* was therefore called *Valisneria verticillata*; but, if I understand M. Poiret aright, it has been proposed by M. Richard to form for it a new genus called *Hydrilla*. (*Enc. Meth. Sup*. v. 136.)

Like the *Valisneria*, the *Janji* no doubt is a diœcious plant, and in order to impregnate the female stigma, which projects above water, from the summits of the branches, the male flowers separate from the plant before the antheræ burst, and, floating on the surface, are entangled among the female branches, before the pollen explodes. In other respects, in even the manner by which the female flowers are elevated above the surface of the water, and in a habit resembling the *caulinia* of Willdenow, or the *Tonina* of Jussieu, the *Janji* totally differs from the *Valisneria*, which is a plant with leaves like grass, and without any stem; whereas the *Janji* has a very branchy long stem, covered to the very extremities with leaves, much like several species of *Potomogeton*, some of which are indeed applied to the purpose of refining sugar; and in this country might supply the place of the *Janji*. The preference indeed given to the latter seems to be owing to its abundance; as great quantities of it grow in almost every pond in India that is not kept clear of weeds. Except in the few circumstances above mentioned, in which the *Janji* resembles the *Valisneria spiralis*, it has a much greater affinity to the *Commelina dubia* of Jacquin, called *Schollera graminifolia* by Willdenow, *Heteranthera graminea* by Vahl, and *Leptanthus gramineus* by Michaux and Hooker. The differences above mentioned, however, seem to me sufficient to separate the *Valisneria alternifolia* and *V. verticillata* from the genus *Valisneria*; and, notwithstanding the utmost affinity to the *Schollera*, to establish the genus *Hydrilla* proposed by Richard.

Dr. Hooker (*Exotic Flora*, No. 94.) places his *Leptanthus* or *Schollera* in the natural order of JUNCEÆ; but I doubt the propriety of separating it from the HYDROCHARIDES, in which M. Poiret places the *Hydrilla*, and to which Mr. R. Brown (*Prod. Nov. Hol.* i. 345.) approximates the *Serpicula verticillata*, which he admits to be a distinct genus, although he does not give it a name.

So far as I know, no description of the *Janji* has yet been published, and I shall therefore give one.

Radix fibrosa.

Caules submersi, filiformes, glabri, ramosi.

Folia alterna, approximata, amplexicaulia, linearia, acuta, integerrima, enervia, venis longitudinalibus confertis striata.

Flores axillares, sessiles, plerumque gemini, dioici.

Masc. Spatha capsuliformis, compressa, acutangula, diaphana, ore bifariam dehiscens. Spadix in spathæ fundo brevissimus, ramosissimus, flosculis semina mentientibus tectus. Flosculi plures, pedicillati, spatha hiante ante antherarum maturitatem disruptis pedicellis enatantes, minuti, albidi, quadrivalves. Antheræ in flore natante dehiscentes, tres, sessiles, obovatæ.

Fœm. Spatha longitudine germinis vaginans, ore obliquo dehiscens. Calyx minutus triphyllus, superus. Germen anceps, mucrone calycem gerente longissimo (digitali) subulato terminatum. Stigmata sex, per paria basi unita, sessilia, oblonga.

Fructus membranaceus, vix dehiscens, sublanceolatus, anceps, acutangulus, acuminatissimus, unilocularis, filamentis umbilicalibus repletus. Semina plura, oblonga, inter filamenta nidulantia. Seminum structura in planta recente non conspicua, germinantia non observavi.

ART. V.—*Contributions to Popular Science.*

THE common objects of scientific inquiry are generally far withdrawn from popular apprehension. Even the systematic details of our elementary works require a degree of preliminary knowledge, and of patient attention, which are not within the reach of ordinary readers; while the researches of those who are permitted to penetrate into the mysteries of nature, and to develope her laws, are accessible only to minds of similar capacities and attainments.

In those branches of science which are susceptible of popular illustration, and in those applications of it which have been so happily made to the wants and purposes of life, the public have long been accustomed to take a deep interest. The mind enjoys a peculiar gratification, not only when it obtains from a striking experiment both the proof and the explanation of a scientific principle, but even when it succeeds in referring the most ordinary facts to some general law, the truth of which it has been accustomed to recognise. From these causes the topics of popular science have always commanded an unusual degree of attention; and while the general reader is amused and instructed by their details, the philosopher often reads them with an interest of scarcely less intensity.

In the following series of papers which we propose to publish in successive numbers, either the facts, or the reasonings, or both, will, we trust, be found to be new; and, with the assistance of some of our able correspondents, we are not without the hope that they will often contain facts and views of some importance to science.

No. I.—*On the Revival of the Inscriptions on Coins and Medals by Unequal Oxidation.*

IT has been long known, though we have not been able to ascertain to whom we owe the discovery, that a coin, from which the inscription and the figures have been entirely effaced, so as not to present the slightest trace of an impression, may have the inscription and figure partly or wholly restored, by placing it upon a hot iron. In order to perform this experiment with the fullest effect, the coin employed should be one equally worn down, and in which very little of the metal has been worn off the hollow parts by which the letters are surrounded.

When a coin of this kind, or what is still better, a coin on which an illegible trace of the letter still remains, is placed upon a heated iron, it will be seen that an oxidation takes place over its whole surface, the film of oxide changing its tint with the intensity or continuance of the heat. The parts, however, where the letters of the inscription had existed, oxidate at a different rate from the surrounding parts, so that these letters exhibit their shape, and become legible in consequence of the film of oxide which covers them having a different thickness, and therefore reflecting a different tint from that of the parts adjacent. The tints thus developed sometimes pass through many orders of brilliant colours, particularly *pink* and *green*, and settle in a bronze, and sometimes a black tint, resting upon the inscription alone. In some cases the tint left on the trace of the letters is so very faint that it can just be seen, and may be entirely removed by a slight friction of the finger.

When the experiment is often repeated with the same coin, and the oxidation successively removed after each experiment, the film of oxide continues to diminish, and at last ceases to make its appearance. It recovers the property, however, in the course of time. When the coin is first placed upon the heated iron, and consequently, when the oxidation is the greatest, a considerable smoke rises from the coin, and diminishes like the film of oxide by frequent repetition. A coin which had ceased to give out this smoke, smoked slightly after twelve hours exposure to the air, having been removed from the hot iron at the beginning of that interval, and replaced upon it at the end of it by a pair of pincers.

From a great number of experiments I have found that it is always the *raised* parts of the coin, and in modern coins the elevated ledge round the inscription that oxidate first. This ledge, in an English shilling of 1816, began by exhibiting a brilliant yellow tint before it appeared on any other part of the coin.

In examining a number of old coins, a brilliant red globule, accompanied with a smell of sulphur, appeared on one or two points of the coin; and sometimes small globules, like those of quicksilver, exuded from the surface. Other coins exhaled a most intolerable smell; and an Indian pagoda became perfectly black when placed upon the heated iron.

Such being the general facts respecting the oxidation of coins, it becomes an interesting inquiry to determine its cause. If we take a homogeneous and uniform piece of silver, and place it upon a heated iron, its surface will oxidate equally, if all the parts of it are exposed to the same degree of heat. A coin, however, differs from a piece of silver of uniform texture, as it has been struck with great force during the act of coining. In this process the sunk parts have obviously been most compressed by the prominent parts of the die, and the elevated parts least compressed, the metal being left as it were in its natural condition. A coin, therefore, is a piece of metal in which the raised letters and figures have less density than the other parts, and consequently these parts oxidate sooner, or at a lower temperature. When the letters themselves are rubbed off by use, the parts immediately below them have also less density than the metal which surrounds them, and consequently, they receive from heat an oxidation and a colour different from that of the surrounding surface. Hence, the reason is obvious, why the invisible letters are revived by oxidation.

A similar effect takes place in the beautiful oxidations which are produced on a surface of polished steel. When the steel has hard portions, called *pins* by the workmen, the uniform tint of the oxide stops near these points, which always display colours different from the rest of the mass.

The smoking of the coin, the diminution of its oxidating power, by a repetition of the experiment, and the recovery of that power by time, seem to indicate that the softer parts of the metal absorb something from the atmosphere which promotes oxidation. Whether this is oxygen or not, remains to be determined. (B.)

ART. VI.—*Observations on the Winter Solstice of* 1823, *made at Paramatta.* By His Excellency Sir THOMAS BRISBANE, K. C. B. F. R. S. L. & E. and M. RUMKER. Communicated by the Authors.

THE following observations of the winter solstice have been made at Paramatta, New South Wales, with a sixteen inch repeating circle of Reichenbach's, and form part of four solstices observed with the same instrument. The observations were begun about ten days before the solstice, and continued as many after it. The instrument was carefully read off at the end of each observation, and left when they were completed, in the same state, until the following day, when it was again read before the renewal of the repetitions, the adjustments again examined; and this course was pursued during the whole period of the solstice. The noon was deduced for the corrections by a five and a half foot transit, by Troughton. During the winter solstice, in consequence of the slow motion of the sun, the repetitions were generally extended to ten in each series when the weather was fine, but in summer, from the rapid change, it was found necessary to limit the series to four or six repetitions. The reduction of the solstice has been completed with the utmost accuracy by M. Rumker. The latitude deduced agrees to the same second with that determined from the former solstice.

1823.	True Zenith Distance of ☉.	Reduction to Solstice.	Correction on Acct. of ☉ Latitude.	Apparent Zenith Distance of the Tropic of ♋.
June 11.	56 50 38 70	25 56 96	+ 0,01	57 16 35 67
14.	57 2 32 22	13 56 56	+ 0,44	29 22
15.	5 48 54	10 45 72	+ 0,58	34 84
17.	10 50 03	5 37 62	+ 0,79	28 44
19.	14 21 27	2 8 48	+ 0,86	30 61
21.	16 9 70	0 18 41	+ 0,79	28 90
22.	16 32 10	0 0 60	+ 0,68	33 38
23.	16 23 20	6 84	+ 0,58	30 62
24.	15 50 12	39 32	+ 0,42	29 86
25.	14 53 10	1 35 83	+ 0,32	29 25
30.	4 1 66	12 29 79	— 0,41	30 04
July 1.	0 39 60	15 53 01	— 0,48	32 13

	57 16 31 08
Luni-Solar Nutation, ...	— 4 32
	57 16 26 76
Reduction to January, 1823, . .	+ 0 25
Mean Zenith Distance of Tropic ♋ 1823,	57 16 27 01
From Winter Solstice ♑, ...	10 20 58 22
½ Sum = Latitude, ...	33 48 42 61
½ Difference = Mean Obliquity, . .	23 27 44 39

ART. VII.—*Journal of an Excursion through the Himalayah Mountains, from Shipke to the Frontiers of Chinese Tartary.** By ALEXANDER GERARD, Esq. Surveyor to the Board of Commissioners, Lieut. and Adj. 2d Battalion, 13th Regt. Native Infantry, on the Bengal Establishment. Communicated by the late Colonel GERARD of Rochsoles.

HAVING halted at this place on the 13th of October 1818, my brother (Dr. Gerard) took a walk of about a mile farther on, with the perambulator and pocket compass; for we did not think it advisable to use the theodolite in the presence of the inhabitants, knowing their extreme jealousy. He had proceeded a little way from the village before he was perceived, when immediately the people dispatched a couple of horsemen after him, and crowded round the tent, making a great uproar. My brother had begun to return before the horsemen overtook him. They told him they had come to bring him back, but seemed in perfect good humour, laughing whilst they spoke. They insisted upon his going before them, and would not dismount when he bade them.

About nine o'clock the Chinese officers, of whom there are several to regulate the affairs of the country, brought sixteen *sers* of flour, which they requested us to receive as a present; and it was no unacceptable one, for our people had but little food for the last three days. In the forenoon the head man showed us a long piece of parchment, written in what we supposed the Chinese characters, and gave us to understand that it was an express order from the Garpan of Garoo, under whose authority the Debas are, prohibiting strangers from entering the country. He at the same time said we had so many people with us, (having nearly one hundred, including a guard of twelve Gorkhalees,) that he could not oppose our progress, but as it would cost him his head if he gave us the means of going on, he would not supply us with provisions; which was the most effectual mode he could have adopted to stop us.

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* The rest of this very interesting tour will be given in our next number; along with a correct map, containing the routes surveyed by Lieutenant Gerard, the route of Mr. Moorcroft, &c.—Our friends in India will oblige us greatly by the transmission of any new information respecting the Statistics and Natural History of that country.—ED.

During the time we were at Shipke it blew a complete hurricane, and the aridity of the wind dried up every thing exposed to it. The leaves of our books were more bent than I ever remember to have seen them in the hot winds, and no dew was observed.

The latitude of Shipke, by the meridian altitude of stars, is 31° 48′, and the longitude 78° 46′. Its extreme height is 10,597 feet, and the thermometer ranged from 38° to 60°.

The people are affable and good-natured, and allowed us to handle their pipes, knives, &c. They thronged round our tent from morning till night, and we found it the most difficult thing to understand them, even with the aid of interpreters. The Koonawur words we had picked up, which were of the utmost use to us during our journey, were not intelligible to the people here. This evening, the things that had been so long in the rear came up.

At sunrise, on the 14th of October, when the thermometer was 38°, and before the inhabitants had risen, I set up the theodolite, and took the bearings and altitudes of the remarkable peaks. One of them, covered with snow, above 20,000 feet in height, is only four miles from the villages, from which it subtends an angle of 28°. Another called Tuzheegung, 22,488 feet high, to the north of the Sutluj, was seen under an angle of 23° 31′. These elevations were observed with the sextant and artificial horizon.

We exchanged a gold button for a goat, which we took with us to Soobathoo. The wool is extremely fine, and almost equal to what is used for the manufacture of shawls.

We were informed the best was procured farther to the eastward, near Garoo, which is the famous mart for shawl wool. The goat scarcely differs from the common one, and it does not appear to be a distinct breed that produces the shawl wool, but its fineness seems to depend almost entirely upon the elevation and coldness of the climate. We ourselves had an opportunity of seeing this. At Soobathoo, 4200 feet above the sea, the wool is little better than in the plains of Hindoostan, but it gradually grows finer as you ascend, and in the Koonawur, where the villages are more than 8000 feet high, it is fit for making coarse shawls.

Garoo, or Gartop, by the accounts of fifteen different people, is reckoned 11 marches from Shipke; and the road, consisting of gentle swellings, is described as being so good that the trade is carried on by Yaks.

After breakfast we returned to Numgeea by the same road as before, and on the 15th October struck off to the N. W. towards Ludak, crossing the Sutluj, a mile from the village, by a crazy bridge, constructed of ropes made of the bark of a tree, with basket-work of twigs, forming a curve, almost the sixth part of a circle. The breadth of the river was seventy-four feet, with a large rock in the middle, occupying forty-two feet. The extreme height of the bed is 8600 feet. This day we travelled over a mountain of 13,186 feet, the ascent of which was very steep, upon rugged rocks, and above 4500 feet perpendicular height. We encamped for the night near a stream at the height of 12,800 feet, and had but a small supply of fire-wood, the country producing nothing but the prickly bush which we saw near Shipke, and another not unlike broom. Distance, seven and a half miles.

Seeing high mountains to the eastward, which appeared to be practicable, and thinking the distance short, we resolved to attempt them, whilst our baggage proceeded direct to Nako, only about three miles from our camp. We accordingly set off on the 16th of October, after an early breakfast, and went up the face of a steep hill for 1½ mile, sometimes over large misshapen masses of granite, sometimes over a gravelly soil, covered with brown whins and various kinds of aromatic shrubs. There was not the least trace of a foot-path, and the prickly bushes impeded us not a little, every moment running into the feet through the shoes, which were of the kind used by the natives; our own stock, from the badness of the roads, having been long since worn out. The height of this station was 14,900 feet. There being another higher peak in front, without snow, that seemed near, we moved towards it, but we never were so much deceived in distance. It took us fully three hours to reach its top, and the ascent was very tiresome, lying over enormous detached blocks of stone, often resting upon small bases, tottering under the feet, and seeming ready to overwhelm us. The last 200 yards were still worse; and we were obliged to use both hands and feet, now climbing up almost perpendicular rocks, and now leaping from one to the other. A single false step might have been attended with fatal consequences; and we were so much exhausted, and had such severe headachs, that we had hardly strength sufficient to make the effort; and it required no inconsiderable one to clear the deep chasms, which we could scarcely view without shuddering. I never saw such a horrid-looking place. It seemed the wreck of some towering peak, burst asunder by severe frost. After much delay we got up the theodolite and a couple of barometers. At four P. M. the mercury stood at 16.170 inches, and the thermometer was 29°, which, compared with corresponding observations, made by Captain Ross at Soobathoo, gives the height 16,921 feet. We observed all the surrounding peaks, and then proceeded to the village of Nako, at a quick pace. The road for the first mile was a steep rocky descent; afterwards a more gradual one to camp, where we arrived at dusk. The distance, by the perambulator, was 10¼ miles, but we must have travelled upwards of eleven; for the perambulator could not be rolled to the top of the highest peak.

From what we saw yesterday we were convinced we could reach a more elevated spot, and thinking the attainment of a great height more desirable than a high latitude, we resolved to try it again, and rather defer our intended journey towards Ludak than let slip such a favourable opportunity. From our experience of the slowness with which the perambulator can be rolled over the large stones, we sent it, together with the large theodolite, a-head at eight, and moved ourselves at ten o'clock on the 17th of October. The road at first was tolerably good, lying upon turf, and passing near some lakes which were frozen over; latterly it was rocky and the ascent fatiguing, but not so difficult as yesterday's. We stopped several times to look out for our people, but not seeing any sign of them, we dispatched a man to Nako, with orders to meet us, and to bring our bed-clothes, a few bundles of fire-wood, and something to eat, whilst we proceeded on to a kind of break between two peaks. The last half mile was generally over snow, and both my brother and I felt completely debilitated, and were affected with severe headachs and pains in the ears. The highest vegetation we saw was a plant with leaves like sage, but without smell, and brown, from the dryness of the atmosphere. It grows at the height of 17,000 feet, beyond which elevation we found no soil.

At the top of our station, between the peaks, where we arrived at four P. M. the barometer showed 15.075 inches, which gives the height 18,683 feet. The thermometer, when first taken out of the case was 30°, but in less than a quarter of an hour it fell to 22° below the freezing point. After taking a few bearings with all possible haste, we set out on our return, and at dark met our servants with our bed-clothes about 1½ mile from Nako, and halted for the night at the height of 13,724 feet, without a tent. Our people had brought wood, but no flint to strike a light, so we sent them back to the village for some fire. It was past eleven before they returned, and during an interval of nearly five hours we sat shivering, for the thermometer was 6° below the freezing point, and we had only a couple of blankets to wrap round us. After we had lighted a fire we made a large quantity of punch, which we continued drinking till near two in the morning, and I do not recollect any thing that ever refreshed me so much. The length of our march to-day was about ten miles, and we ascended 6800 and descended 5000 feet of perpendicular height. The people with the perambulator and theodolite missed the way, and did not arrive till midnight, and their hands and feet were almost frozen.

The thermometer at sunrise, on the 18th October, was 16°, and the cold intense. We could not sleep much owing to it, for excepting a few sticks which we kept for the purpose of preparing breakfast, our fire-wood was exhausted.

We wished much to see the barometer below 15 inches, and determined to make another attempt to reach the summit of a peak north of our yesterday's station, which appeared 600 or 700 feet higher. Being now 1¼ mile nearer to it than before, we had every hope of succeeding, and therefore sent off our things as soon as we could prevail upon our people to move, which was not, however, before nine o'clock. We were well equipped with instruments for making all requisite observations; we took with us three barometers, two thermometers, a large theodolite, a small one, a perambulator, a telescope magnifying eighty times, and a smaller one, together with a bundle of sticks, the boiling point of water, and a sextant and artificial horizon for ascertaining. We marched a little after ten, and overtook our people not a mile from our halting place. We had infinite trouble in getting them to go on, and were obliged to keep bawling out to them the whole way, at one time threatening, and at another coaxing them. To tell the truth, however, we could not have walked much faster ourselves, for we felt a fullness in the head, and experienced a general debility, which, together with headache and pains in the ears and breast, affected us more than the day before. A cold wind that benumbed our hands sprung up, and increased with the height, till about three P. M. when it died away. After much annoyance we reached the place where we put up the barometer yesterday. Here the man who carried the bundle of sticks sat down, and said he must die, as he could not proceed a step farther, and neither a sound thrashing nor the promise of a handsome reward could induce him to move; we accordingly left him, and, after an ascent of 700 feet, attained the top of the peak, 19,411 feet above the level of the sea. The road latterly lay over disunited blocks of granite, between which we found large lumps of ice transparent as crystal. We got up the last ascent without much difficulty; which is somewhat surprising. It was four P. M. when we gained the summit, so that we had not time to make half of the observations we wished. The thermometer was not below 22 degrees, but, owing to the wind on the way up, my hands were so benumbed that it was not until I had rubbed them for a quarter of an hour that I got the use of them. Whilst I was setting up the large theodolite, my brother tried three excellent barometers, which we had the satisfaction to see stand exactly at the same point, 14,675 inches.

The Tuzheegung had an elevation of 17 degrees, and was not more than two miles distant. The ink froze, and I had only a broken pencil, with which I got on very slowly. It was twenty minutes to five before we had finished our observations; the thermometer was 11 degrees below the freezing point; and we had 7600 feet of perpendicular height to descend, over a bad road, in a distance of six miles. We cautioned our people against delay, and moved downwards as fast as we could walk. We passed the bundle of sticks where it was left; but the man had disappeared, and we next day understood he had reached camp before us. Night overtook us two and a half miles from Nako, and my brother had the misfortune to fall, and hurt his leg so much, that we greatly feared he would be obliged to remain where he was until assistance could be obtained from the village. After sitting down for half an hour, he found himself able to proceed at a slow pace; so we moved on, and shortly after lost the road, by going too far to the right. We got in among a confused jumble of gigantic masses of rock, from which we found it no easy matter to extricate ourselves. We wandered about among them, almost as chance directed, for an hour and a half. Many of the stones shook under us, and we passed places frightful even in day-light. About nine, we espied a light below us, and heard the roaring of the River Lee, which, as it was then very calm, seemed quite close to us. This made us imagine we had gone beyond the village; but, judging from the strange structure of the surrounding mountains, which we could scarcely mistake, we did not think it possible we could have done so, more especially as we had seen no cultivation, and there are a good many fields around Nako; we therefore went on, and came to a Lama temple, that we recognised about a quarter of a mile from camp. We called out, and were answered by some of our people, who came to meet us with a couple of lights.

We reached camp at half-past nine, not so much tired as might have been expected. Only four of our servants arrived that night; the rest stopped without fire at our former halting place, and came up late next day, having their feet so much swollen by the frost as to be unable to carry loads during the rest of our journey. The distance to-day was ten and a half miles.

Our last three marches were fraught with accidents. Three barometers, a perambulator, and thermometer, were smashed in pieces, and the small theodolite, a very neat instrument by Dollond, divided into single minutes, with a brass stand, was rendered unfit for taking elevations, the nonius having been broken off. We had remaining a strong perambulator, two large theodolites, a surveying compass, four barometers, and as many thermometers, together with a couple of sextants, a reflecting circle, a repeating circle, and a chronometer; so that we were still very well supplied with instruments.

We have great reason to be thankful, that, during the last three days, there was very little wind, and none at all when we visited the highest peaks; for, had there been any when the thermometer was so low, it must have chilled us so much, that we could not have moved, and to have remained during the night at such a height would have been almost certain death.

As many of our people were unable to walk, from fatigue and sore feet, we halted on the 19th.

The village of Nako is the highest we met with during our tour, being not less than 11,850 feet above the sea. It is pretty large, and inhabited by Lama Tartars, rather different in appearance from those at Shipke. There is more cultivation about it than might have been expected considering its elevation; the fields, which are chiefly wheat, ogla, phupra, and batoo, extend to the height of 13,000 feet, and have stone dykes around them. Yaks are here used in the plough; they are hardy animals, but often vicious. The grain produced, as at most other villages in Koonawur, is insufficient for consumption, and the people subsist by their flocks. There is a pond near this, surrounded by apricot trees, upon which, in winter, the boys amuse themselves by sliding; but they do not know the use of skates.

This morning, at sunrise, the thermometer was 18 degrees below the freezing point; a shower of snow had fallen upon the adjacent mountains, and every thing indicated the sudden approach of winter. It was now time for us to think of returning, and we decided upon going no farther than Shealkhur.

We here received a visit from the Wuzeer Loktus, who has the charge of Hungrung, one of the subdivisions of Koonawur, containing ten or twelve Tartar villages, which lie on both sides of the River Lee, from Shealkhur to the Sutluj. He came here to collect the revenue, and brought us a couple of Chourees, and some fine purple grapes from Soognum.

On the 20th of October we marched to Chango, nine miles. The road was in general good and broad, great part of the way, lying about a mile from the left bank of the River Lee. We found clay at the height of 12,000 feet, which, I believe, is not common. Chango is situated on a pleasant spot between two rivulets near the Lee.

We marched on the 21st to Shealkhur, a fort and village belonging to Busehur, under the command of Loktus. Its distance from Chango is three and a half miles. The road was indifferent along the left bank of the Lee, until under the village, where we crossed it by a bad wooden bridge. The bed of the river is here 10,000 feet above the sea, and the breadth of the stream ninety-two feet, but it is not nearly so rapid or deep as the Sutluj.

The fort of Shealkhur is situated in lat. 32°, and long. 78° 38′, upon the confines of Ludak and the Chinese dominions. It is in a most ruinous state, and the village is a poor place.

The first Ludak village was said to be a day's march to the northward; but, as a single fall of snow might have shut up the passes, we abandoned the idea of visiting it.

From Koonawur to Garoo there are three roads. One from Shipke has already been mentioned: another from Shealkhur, not so good as the former, lies through Choomeerstee, an elevated country under a Deba, where the people dwell in tents, do not cultivate the ground, and subsist by their flocks. The third road from Nisung crosses part of the Himalaya range, at a pass called Gangtung, which is represented as being extremely difficult. It is worthy of remark, that the Koonawurees estimate the height of mountains by the difficulty of breathing they experience in ascending them, which, as before noticed, they ascribe to a poisonous plant; but, from all our inquiries, and we made them almost at every village, we could find nobody that had ever seen the plant, and from our own experience, we are inclined to attribute the effect to the rarefaction of the atmosphere, since we felt the same sensation at heights where there were no vegetable productions. The traders who cross Gangtung Pass put on so many clothes to defend themselves from the excessive cold, that they can scarcely walk. They wear a large garment, with sleeves reaching down to the feet, made of sheepskin, with the woolly side inwards, trowsers and stockings of the same material, a kind of rude gloves of very thick woollen stuff, and caps and shoes of blanket; they likewise, occasionally, wrap three or four blankets round them, and, thus accoutred, set out on their perilous journey. No grass is met with on the way for two days; and travellers are said to have dreadful headachs and pains in the ears even when at rest. Many goats and sheep die annually; and it is no uncommon thing for the people that attend them, who also sometimes perish, to lose their fingers and toes. This road leads past Chubrung, and crosses the Sutluj at Chuksum Sango, (a wooden bridge with a railing of iron chains) under Tooling, a large collection of tents, where there is a temple with a gilt cupola roof, held in great repute among the Lamas.

Leh, the capital of Ludak, on the right bank of the Indus, is reckoned sixteen days journey from Shealkhur. There are several roads to it from Koonawur, one from Wangpo, another from Soongnum, and two from Shealkhur; they are rocky at first, but afterwards improve. Leh is about midway between Kashmeer and Garoo, being eighteen marches from either.

On the 22d October we proceeded to Lee, a village on the right bank of the Lee river, near the junction of a small stream with it. The distance is twelve miles; and as it was late when we started, we did not reach it until upwards of an hour after dark, and half our baggage did not arrive that night. The road was bad, crossing two rivulets, the ascent from the latter of which was extremely tedious and dangerous, being very steep, upon sand and gravel that seemed to have but recently fallen. It was a natural slope, and the greatest caution was requisite to avoid putting the loose earth in motion, for there were no marks of a foot path: with all our care, however, it was not unfrequent to slip back many yards, and some times near 100 feet of sand gave way at once, carrying the traveller along with it, but not very quickly: the greatest danger arose from stones displaced by our people who were a-head, which every now and then whirled past us with astonishing rapidity.

On the 23d October we marched seven and a quarter miles to Hango, situated on the bank of a stream flowing to the eastward, to mix its waters with the Lee: this valley contains five or six villages, around which there is more cultivation than in general we had seen in Koonawur. The road commenced with a steep ascent of 2500 feet, and was then good and even to Hango, 11,468 feet above the sea.

We marched to Soongnum, on the 24th, a distance of nine and a quarter miles. At first we had an ascent of 3400 feet, by a good but steep road to the top of Hungrung Pass, 14,837 feet in height. This pass separates Hungrung from another of the divisions of Koonawur, named Shooung, under the Wuzeer Budreedas: the mountains immediately on either side might be fully a thousand feet above us; but there was little snow upon them, and none at all in the Pass itself. The wind blew with irresistible violence; and although the thermometer was four degrees above the freezing point, it chilled us so much that the numbness of our hands continued almost until we reached Camp, to which we descended by a good broad road, cut into long zigzags, and crossed by some rivulets entirely frozen. Soongnum is a town of considerable extent and beauty; it is situated on the point under which the Darboong and Boukeeo unite; the former is a stream of some size, and comes from the north-west. The latter is small, and has its source near Hungrung Pass.

The dell through which the Darboong flows, is broad and level, and almost an entire sheet of cultivation for about three miles. It is a most romantic spot, and the extensive vineyards and number of apricot trees with which it is interspersed, have a fine effect. It is shut in to the north and south by mountains, not under 14,000 feet high; to the north-west is a steep and high pass to Ludak, and on the eastward lies the Sutluj, which the Darboong joins under the village of Sheasoo, four or five miles farther down the glen.

Soongnum is inhabited chiefly by Lamas; and its extreme height is 9840 feet. Trees, which we had not seen since we left Numgeea, appeared in this vicinity thinly scattered upon the surrounding mountains: they consist of keloo, or kelmung, and ree, both varieties of the pine: the last kind, which produces the neoza almond, in shape resembling the pistachio nut, and in taste not inferior, is peculiar to Koonawur, and does not grow to the westward of the Buspa or Wangpo rivers.

In the evening we were entertained with a Lama concert, which was far from disagreeable; the music was high and low alternately, one set singing the bass, and another the treble.

Art. VIII.—*On the Regular Composition of Crystallized Bodies.* By William Haidinger, Esq. F.R.S.E. Communicated by the Author.

From the earliest period of the application of geometry to the regular forms of minerals, the consideration of what is commonly termed twin-crystals, or hemitrope crystals, has formed one of the most interesting parts of the science, and has deservedly fixed the attention of naturalists. For the first scientific explanation of the law, according to which some of them are formed, we are indebted to Romé de l'Isle and L'Hermina, who succeeded in unravelling the mystery, which, till that time, seemed to separate the forms of Spinel, of Tin-ore, &c. from those of other minerals. In the present state of crystallography, the explanation of these twin-crystals is not attended with the least difficulty, even to a beginner; but it required uncommon sagacity to establish the first well-authenticated instances. How difficult this appeared to the mineralogists of that period, we may judge from the invitation of Linnæus to naturalists, who might succeed in ascertaining their forms, to favour the public with the description of the crystals of Tin-ore, one of those at present most easily explained: *Stanni crystallini veram et distinctam figuram qui eruere poterit, eamdem publico non invideat.*[*]

The names Macle and Twin-crystal are older than the geometrical explanation of any of them; the former used by Romé de l'Isle, the latter by Werner and his followers. The term *Zwitter*, which had for centuries been applied to Tin-ore by Saxon and Bohemian miners, and twin-crystal, indicate vaguely a composition of two crystals, without, however, referring them to any determined position. Haüy supposed that, in general, their form might be explained by considering a perfect crystal cut into two halves, one of which is revolved in the plane of intersection through an angle of 180° or one-half circumference. He founded upon this explanation the term of hemitrope crystals, which expresses very well some of the general geometrical properties of regularly compound minerals. Haüy himself has since explained many twin-crystals not known before, and many new and curious ones have likewise been discovered and described by Count Bournon in Calcareous spar, &c.; Mr. Phillips in Tin-ore, &c.; Professor Weiss in Quartz, in Felspar, in Chabasie, &c. As the occurrence of twin-crystals in nature is very general, and as many of them have been perfectly explained, the stock of information in this respect is already large and valuable; but the various facts have never yet been collected within the exact limits of certain general laws, by means of which all of them might be explained.

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[*] *Syst. Nat.* 1768, p. 130.

To give a general view of these facts, is the object of the present series of papers. It does not enter within their limits to give a full account of the means of ascertaining the simple or compound state of minerals; but it is supposed that the regular composition is already known to take place, and it is their object to trace the laws by which this composition may be explained. Among these means, however, the only pure crystallographic character, which always necessarily must be found, is the exactly reversed situation of certain parts of one individual, in respect to homologous parts of the other. Re-entering angles are very often produced, yet they are not a necessary consequence of regular composition. The striæ frequently occurring upon the crystalline faces, being the expression of some other form combined with that whose faces we observe, very often lead to the discovery of composition. The phenomena of cleavage and of double refraction, being intimately connected with the regular forms of minerals, are capable of being applied to a great extent in examining the simple or compound state of minerals; they are of great and equal value in the present place, though both of them, strictly speaking, are foreign to the pure crystallographic consideration of minerals.

Whenever the mode of junction of two regularly formed individuals is to be explained, we have to attend, 1st, To the relative position, and 2dly, To the faces of contact of the individuals with each other. If these can be ascertained and reduced to some general law, the composition is regular, and yields twin or hemitrope crystals; if the composition be irregular, the product will be groups of crystals or geodes, which, if the regular form of the individuals be destroyed by their contact with each other from all sides, will terminate in globular, botryoidal, reniform, and other external shapes, or in massive varieties, consisting of granular, columnar, or lamellar particles of composition.

The general laws, to which, in the crystallographic system of Mohs, all regular compositions are referred, consist in the following geometrical constructions.

I. Suppose two equal and similar regularly crystallized individuals of the same species to be in a parallel position. Turn one of them round a certain line, which is called the *axis of revolution*, through an angle of 180°, while the situation of the other remains unchanged. The axis of revolution must be parallel to an edge, or perpendicular to a face of one of the simple forms occurring in the species. This is the *position* in which the two individuals will join. The face in which they touch each other, or the *face of composition*, is either perpendicular to the axis of revolution, or this line lies in the face of composition itself, which, in the latter case, is always parallel to a face of the series of crystallization of the species.

The individuals may terminate at the face of composition, or they may continue beyond it. Very often the regular composition takes place on more than one of the similarly situated parts of an individual, or it is continued in more or less thick laminæ parallel to itself.

II. In those species whose forms possess the peculiar property of showing only half the number of those faces which their absolute geometrical symmetry would require, the two individuals to be joined, may assume such a position, that the faces of the one are, as it were, supplemental to those of the other, as in the two tetrahedrons, Plate III. Figs. 1 and 2, when they join in the composition, Fig. 3; where these faces assume the situation of those of the octahedron, Fig. 4, from the resolution of which they are obtained.

The second law, in most cases, gives the same result as the first. It is deserving of notice, that whenever a regular composition can be explained by this law, the faces of composition are less apparent, which may originate in the circumstance, that more than one of the faces of the one individual are rigorously parallel to as many of the faces of the other.

These two laws contain the geometrical construction of the regular form of twin-crystals. Perfect regularity is supposed to take place in each of the individuals. Mineralogists, who have observed nature, will be perfectly aware, that even simple crystals seldom present themselves in this state; and the compound ones are, on this very account, still more subject to accidental irregularities. Yet these irregularities never affect the exact position of the two individuals, without throwing the aggregate itself out of the class of regular compositions into that of irregular ones.

The cause of the formation of twin-crystals has been sought by Haüy and other philosophers, in a certain polarity prevailing during the process of crystallization. This may account for the circumstance, that the particles of a mineral, which is forming out of a fluid, always join with that which is already present, either in a perfectly parallel position, or in one differing from the former by 180°. The power of crystallization, however, acts only to a very limited distance. In allowing solutions of salts to evaporate, we may often observe how the absolute weight of small crystals already formed, and the power of crystallization concur in fixing the position of those crystals which are formed in the fluid. The accrescence of different parts of a crystal is entirely accidental; and thus likewise it may happen, that throughout the mass of an apparently simple and homogeneous crystal, there are contained numerous particles of the same mineral in an opposite direction. From the same point of view, also, we must consider the circumstance, whether the two individuals terminate at the face of composition, or whether they continue beyond it; and likewise the repetition of the same law, either parallel to itself, or in several homologous directions relative to the same individual.

According to these observations, it will be interesting to compare the regular compositions, occurring in different species of the same system of crystallization, with each other, and to consider the different laws which may occur in one and the same species.

I. *Tessular System.*

In the tessular system the situation of the two individuals which are regularly composed, is always comprised within one of the two following cases. Either, 1st, The axis of revolution is perpendicular to one of the faces of the octahedron, and the face of composition parallel to it; or, 2dly, The axis of revolution is perpendicular to one of the faces of the (rhomboidal) dodecahedron, and the face of composition parallel to it. In the first case, the two individuals sometimes terminate at the face of composition, sometimes they are continued beyond this face; in the second case, that continuation of the individuals beyond the face of composition has been hitherto observed in every instance, where this mode of regular composition occurs.

Both these cases of regular composition enter within the first of the above-mentioned laws; but that in which the face of composition is parallel to one of the faces of the dodecahedron, will be explained more naturally according to the second law, since it can only be found in those species, which present half the number of faces of certain simple forms entering into the combinations, and which for this reason are named semi-tessular.

As the situation of the axis of revolution and of the plane of composition, is determined in respect to the crystalline forms of the species, it will always be possible to express the regular composition by crystallographic signs, a circumstance which greatly adds to a clearer and more elegant representation of the subject. The sign of the octahedron in the method of Mohs being O, that of one of its faces will be $\frac{O}{4}$ which is included in braces, thus $\left\{\frac{O}{4}\right\}$, and added to the sign of the crystalline form of the individuals, in order to indicate that the regular composition takes place parallel to one of the faces of that solid, implying at the same time that the axis of revolution is perpendicular to this face. Thus, the crystallographic designation of Fig. 5 will be O, $\left\{\frac{O}{4}\right\}$, which expresses that two individuals, whose form is the octahedron, are joined in a regular composition parallel to one of their faces. The edge A, produced by the meeting of the two individuals, is equal to double the edge of the octahedron, or = 218° 56′ 32″, while B, its supplement to 360°, is = 141° 3′ 28″.

The twin-crystal now described, is one of those most commonly met with in nature. It is well known in Spinel, in Automolite, in Diamond, in Magnetic Iron-ore, and in Blende; I have likewise observed it in Nitrate of Lead, and occasionally in Alum, and in native Silver, of the latter of which there is a specimen in Mr. Allan's collection.

The regular composition in Spinel sometimes takes place at the same time, parallel to two of the faces of the octahedron. The result is an aggregate of three individuals, like Fig. 6, and expressed by O, $\left\{\frac{O}{2}\right\}$. A very distinct specimen of this variety, of considerable size, is preserved in the collection of Mr. Allan. Another curious instance of a regular composition in this species, is represented in Fig. 7. It depends upon the same law, but part of one of the individuals reaches over the face of composition, so as to have its faces *o′* on the same level as the face *o* of the other individual. Very often the individuals of the composition are considerably depressed in the direction of the axis of revolution.

Diamond receives an additional interest in the eye of the crystallographer from those numerous instances of regular composition, which detract from its value as an ornamental stone. If, instead of the octahedron, as in Fig. 5, the form of the individuals is the tetraconta-octahedron combined with the octahedron, and if at the same time, the compound crystal is very much depressed in the direction of the axis of revolution, this twin-crystal assumes the appearance of Fig. 8, much resembling a three-sided pyramid, with truncated apices, each of the faces of the pyramid being marked with a slight salient angle. The faces situated at the apices are highly smooth and even, and belong to the octahedron; the other faces are more or less curved, and belong to the tetraconta-octahedron. Generally the lateral faces of the forms entering into the combination are still observable, and often produce re-entering angles at the plane of junction. The knots, which have been described as existing in the interior of Diamonds, from which the structure runs in an opposite direction, are evidently derived from lamellæ, engaged in the interior of crystals in an exactly opposite sense. They depend upon the same law as the composition of Spinel; and layers of considerable thickness of the two individuals may often be observed alternating with each other.

The twin-crystals of native Copper, joined according to the same law, are indicated among the crystalline forms of this mineral by Haüy,* who describes a variety of the form of an isosceles six-sided pyramid, with truncated lateral edges, under the denomination of *cuivre natif trihexaëdre*, without, however, mentioning it to be a regular composition. The angle at the terminal edge of these isosceles pyramids is nearly =143°. I have also observed the truncations of the lateral edges, which correspond to the faces of the rhomboidal dodecahedron, though not alone in connexion with the pyramid now described. A very beautiful crystal of native Copper, from Nalsoe in Faroe, brought home by Mr. Allan, and now in his cabinet, presents the form of an icositetrahedron, like Fig. 9; all the edges of which are = 143° 7′ 48″. The edges A, B, A, B, &c. contiguous to every solid angle formed by six faces, are equal, and if all those contiguous to two opposite ones of them were enlarged, till the rest disappear, the result would be an isosceles six-sided pyramid, Fig. 10. The same evidently will take place, if one half of the crystal is supposed to have been turned in respect to the other through an angle of 180° round the rhombohedral axis, joining the two solid angles in question; and we obtain the solution of the problem in the latter of these suppositions, since it would be impossible to account in a simple tessular crystal for a similar want of symmetry; whereas in regular compositions, like the preceding one of Diamond, we have numerous examples of a depression of the compound crystal in the direction of the axis of revolution. The re-entering angles, sometimes observable, complete the proof that there really exists regular composition. The otherwise powerful and decisive tests of cleavage and double refraction for ascertaining the simple or compound state of a mineral, cannot be applied to the ductile and opake crystals of native Copper.

The same mode of regular composition occurs so frequently in Blende, that it is scarcely possible to obtain a specimen free from indications of its existence. It is found very often in the crystals of that substance, as described by Haüy, and also in massive varieties, consisting of granular particles of composition. The form of cleavage of Blende being the rhomboidal dodecahedron, and the face of composition consequently perpendicular upon one of its rhombohedral axes, we may sometimes succeed in extracting a compound form of cleavage like Fig. 11, where the upper apex is in a transverse position in respect to the lower apex of the three-sided termination, so that a face corresponds to a face, and an edge to an edge on the opposite apices. In this species also, thin films are very often engaged in the mass in an opposite direction, or alternate with each other. As the faces *P* and *P'* of the two individuals coincide in one plane, cleavage will yield something like a regular six-sided prism from a mass thus composed of alternating laminæ of two individuals. These prisms may be terminated either by rough faces, consisting of portions of the inclined faces of cleavage, not continuous, or by a face of composition, perpendicular to the axis of the prism. The latter is the case in the varieties from Przibram in Bohemia, and has induced some mineralogists to consider them as belonging to a particular species, distinguished from Blende by its cleavage, supposed to belong to the rhombohedral system, persuaded no doubt in a great measure by the circumstance, that, among all the known varieties of Blende, these contain the greatest proportion of Cadmium. There are crystals of Blende, composed in the manner described just now, which, by a symmetrical juxta-position of new matter, have assumed the appearance of Fig. 12. Of this variety I saw a very distinct specimen in the collection of the late Mr. Blöde of Dresden, which is now in the possession of Mr. Cogswell. For the sake of distinguishing by their crystallographic signs this regular composition and that mentioned above, it will be sufficient to denote by the number 2 that the individuals do not terminate at the face of composition, but that they both are continued beyond it, thus: $O, 2\left\{\frac{O}{4}\right\}$.

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* *Traité*, 2de éd. tom. iii. p. 425.

The composition of two hexahedrons, so very common in Fluor-spar, and described by Whewell in the Cambridge Memoirs, depends upon the same law; the axis of revolution being perpendicular, and the face of composition parallel to one of the faces of the octahedron. The individuals are continued beyond the face of composition. Sometimes a small part only of the one individual is found to stick out above a face of the other, though always in the constant situation here described. Supposing the axis of revolution A X vertical, the inclined re-entering angles at *a′b′*, *ab*, Fig. 13, are =228° 11′ 23″ (=361° —131° 48′ 37″), and the horizontal ones at *bb*, *b′c′* =250° 31′ 44″ (=360°—109° 28′ 16″). It is deserving of notice, that among the almost innumerable quantity already observed, there has not been a single one showing this regular composition in reference to more than one of the rhombohedral axes at a time. According to the preceding observations, the sign of the twin-crystals of Fluor-spar will be H, $2 \left\{\frac{O}{4}\right\}$.

Regular compositions of the kind described above, are not rare among the crystals of native Gold. The collection of the Johanneum at Gratz, in Stiria, contains examples of the form, Fig. 14. The icositetrahedron of Gold is not, as is commonly stated, that, whose angles of incidence are at the edge A = 131° 48′ 36″, at B = 146° 26′ 33″; but it is the other variety, where A is = 144° 54′ 11″, and B = 129° 31′ 6″. This form has been described by Haüy in the species of Spinel, Fluor-spar, and Lead-glance; and occurs, besides, also in native Silver, in magnetic Iron-ore, and other species.

Lead-glance affords another example of regular compositions, particularly in the combinations of the hexahedron and the octahedron. This species presents both varieties, such as consist of two individuals terminating at the face of composition, and such as consist of individuals reaching beyond this face. They are very often depressed in the direction of one of their rhombohedral axes, and thus assume a tabular aspect, like Fig. 15.

In the semi-tessular species of gray Copper-ore the same law of composition prevails, but gives rise to a very curious appearance of the compound crystals. In the tetrahedron, without additional faces, and supposing the axes of the two individuals of the same length, the result would be as represented in Fig. 16, the face of composition being situated like ABCDEF in Fig. 17, and the two individuals continued beyond this face. This mode of regular composition is not at all uncommon in gray Copper-ore. Fig. 18 represents a beautiful crystal, in the possession of Mr. Sack of Bonn, from the mines of Dillenburg.

The second law of those above mentioned, or that where the axis of revolution is perpendicular, and the face of composition parallel to one of the faces of the dodecahedron, cannot occur in tessular forms of absolute symmetry; because, if we suppose a form of this kind to be joined to another in a position differing from it by an angle of 180°, the faces of the one will be exactly parallel to the faces of the other. It is confined, therefore, to the semi-tessular forms, or those in which some of the simple forms which they contain appear only with half the number of their faces.

The only two mineral species in which this mode of composition has yet been observed, are the hexahedral Iron-pyrites and Diamond. Professor Weiss has first observed, and very accurately described, the cruciform twin-crystals of the first, as represented in Fig. 19; and he has explained their formation agreeably to the second one of the above-mentioned laws, one of the individuals of the composition, Fig. 20, taking the inverse position of the other, Fig. 21; so that, by a combination, they would reproduce the icositetrahedron, Fig. 9, from which they may be obtained by the process of enlarging the alternating faces till the rest disappear. This position of the two individuals may also be obtained by turning one half of the individual 180 degrees round an axis, perpendicular upon the face ABCDEF, as shown in Fig. 22; which produces the cruciform one of Fig. 19, if the substance of the individuals is supposed to reach beyond the face of composition.

The mode of regular composition in Diamond has been observed at an earlier period than that of Iron-pyrites. Mr. Mohs mentions, in his description of the cabinet of Mr. von der Nüll of Vienna, crystals of the general outline of tetrahedrons, with their faces divided into three, and their apices truncated, which are joined so as to appear to penetrate each other. Romé de l'Isle likewise had observed this law of composition, and given a representation of it in Tab. I. Fig. 38; which, however, refers to gray Copper-ore, among those varieties from the Hartz which are covered with a thin stratum of Copper-pyrites.*

He does not quote this twin-crystal among those of Diamond. The crystalline forms of Diamond are much more varied and interesting than they would seem to be from the descriptions published in many mineralogical works, but this is greatly owing to their regular composition. Semi-tessular forms are very common in the simple varieties; for instance, icositetrahedrons, as represented in Fig. 23. Very distinct specimens of this kind are contained in the Wernerian collection at Freiberg. Mr. Allan had likewise observed the same variety in a beautiful crystal in his own cabinet. The surface of the crystals is generally perfectly smooth, though curved, but greatly inferior in lustre to the faces of the octahedron. Also the tetrahedron itself, or the tetrahedron with truncated apices, is met with in this species, but chiefly in compound crystals of the form Fig. 24. Supposing the individuals to be tetrahedrons, the composition would assume the aspect of Fig. 3. The combination of the above-mentioned icositetrahedron with a tetrahedron in the inverse position, if composed according to the same law, gives Fig. 25, one of the most curious twin-crystals found in Diamond, and, at the same time, one of those which occur most frequently in the species. Very often the dodecahedrons are owing to a composition of this kind, repeated several times parallel to itself in thin laminæ. The dodecahedrons thus formed appear deeply furrowed in the direction of the longer diagonals of their rhombic faces; but, if the laminæ are very thin, the product will be a dodecahedron striated in the direction of the longer diagonals of its rhombic faces, and in which very often we may still discover traces of the edges marked *n* in the figure, in the direction of the shorter diagonals, indicating the icositetrahedron contained in the form of the individuals. Of these varieties of Diamond, I have observed specimens in Mr. Allan's collection.

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* *Crystallographie*, vol. iii. p. 328.

(To be continued.)

Art. IX. — *Observations on the Temperature of the Sea and the Air, made during a Voyage from Ceylon to the Cape of Good Hope, in* 1820. By John Davy, M. D. F. R. S. &c. &c. Communicated by the Author.

The observations contained in the following paper, commence in the Indian Ocean, about 19°, directly south of the Island of Ceylon, and terminate in Table Bay at the Cape.

The hygrometrical measures contained in the fourth column, are the differences between the simultaneous indications of two thermometers, one of which has its bulb covered with a bibulous substance, and wetted with water.

Feb. 21. 1820. S. Lat. 12° 52′, E. Long. 79° 57′.

	Air.	Water.	Hygr.	Wind and Weather.
7^h A. M.	77°	81°	2°	W. NW. fresh, overcast.
12	77	81.5	1	Do. do. do.
5	77	81.5	2	Do. gentle, do. slight rain.

The night was rainy and squally.

Feb. 22. S. Lat. 14° 28′, E. Long. 79° 10′.

	Air.	Water.	Hygr.	Wind and Weather.
7^h A. M.	76°	81°.5	1°	N. fresh, raining hard.

The night was stormy and rainy.

Feb. 23. S. Lat. 16° 28′, E. Long. 77° 40′.

	Air.	Water.	Hygr.	Wind and Weather.
12^h Noon.	78°	80°	3°	SE. violent, partially cloudy.

The night was moderate ; the storm abating.

Feb. 24. S. Lat. 17° 32′, East Long. 74° 29′.

	Air.	Water.	Hygr.	Wind and Weather.
12^h Noon.	77°	79°.5	5°	SE. fresh, overcast.

The night was fine, and the wind fresh.

Feb. 25. S. Lat. 19° 15′, E. Long. 71° 56′.

	Air.	Water.	Hygr.	Wind and Weather.
12^h Noon.	80°	80°	6°.5	SE. fresh, rather cloudy.
2 P. M.	79	79.5	6.5	Do. do. showery.
6	79	80	5	Do. do. pretty clear.
10	79	79.75	5.5	Do. do. clear.

The night was fine.

Feb. 26. S. Lat. 21° 32′, E. Long. 69° 29′.

	Air.	Water.	Hygr.	Wind and Weather.
6½^h A. M.	78°	79°.75	7°	SE. fresh, clear.
10	79	79.5	7	Do. do. do.
12	79	79	9	Do. do. rather cloudy.
2 P. M.	78	78.5	6	Do. do. overcast after a shower.
4	77	78	5.5	Do. pretty clear.
6	76.5	77.5	5	Do. clear.
9	76.5	77.5	5.5	Do. do.

The night was fine. During the last two days we appear to have been in a current flowing from the NE. or thereabouts. This inference was drawn from the temperature of the water, and was confirmed by the observations of the Captain.

Feb. 27. S. Lat. 23° 32′, E. Long. 66° 49′.

	Air.	Water.	Hygr.	Wind and Weather.
6½h	75°.5	77°	6°.5	SE. moderate, clear.
10	78	77	8.5	Do. do. do.
12	78°	76°	8°	SE. moderate, clear.
2 P. M.	76.5	76.5	7.5	Do. do. do.
6	75	76	5.5	S. by E. do. do.
10	75	—	5	Do. do. do.

The night was fine, the breeze was gentle, and there was little swell.

Feb. 28. S. Lat. 24° 9′, E. Long. 64° 15′.

	Air.	Water.	Hygr.	Wind and Weather.
6½h A. M.	74°	77°	5°	S. by E. gentle, pretty clear.
10	77.5	77.5	7.5	Do. do. do.
12	78	77	8	Do. do. do.
2 P. M.	76	77	6.5	Do. do. do.
6	75.5	76	6.5	Do. do. do.
9	70	—	7	Do. do. very clear.

The night was very fine, and the breeze gentle. The degree of evaporation at 9 P. M. was very surprising. Under so clear a sky, and so gentle a breeze, dew would have formed in Ceylon. The dryness of the air at sea, at a great distance from land, is a subject that merits attention and investigation.

Feb. 29. S. Lat. 24° 34′, E. Long. 61° 56′.

	Air.	Water.	Hygr.	Wind and Weather.
6h A. M.	74°	76°.5	6°	S. by E. gentle, clear.
10	76.5	76.5	7.5	S. do. do.
12	77	77	8	S. by E. do. do.
2 P. M.	76	77	7	Do. do. do.
6	76	76.5	7	Do. moderate, do.
9	76	—	7	Do. do. do.

The night was fine, and the wind moderate.

March 1. S. Lat. 25° 6′, E. Long. 58° 42′.

	Air.	Water.	Hygr.	Wind and Weather.
6½ A. M.	76°	76°.5	8°.5	E. by S. moderate, clear.
10	77.5	77	8.5	Do. do. do.
12	78	77	7	Do. do. pretty clear.
3 P. M.	77.6	77	6.5	Do. do. do.
6	77	77	6	Do. do. do.
9	77	—	6	Do. do. rather clear.

The night was cloudy, and the wind rather fresh. About noon there was a pretty strong current setting to the west, and a little to the south.

March 2. S. Lat. 26° 7′, E. Long. 55° 48′.

	Air.	Water.	Hygr.	Wind and Weather.
6½h A. M.	77°	76°.5	8°	E. by S. moderate, overcast partially.
10	78	77	10	Do. do. slightly overcast.
12	78	77.5	10	Do. do.
3 P. M.	77	77.5	8	Do. do. pretty clear.
6	77	78.5	7	Do. do. do.
8	77	—	7	Do. do. do.

The night was fine, and the breeze steady. During the twenty-four hours before noon the current was setting more to the north. There was a considerable swell from the east before noon.

March 3. S. Lat. 26° 43′, E. Long. 52° 54′.

	Air.	Water.	Hygr.	Wind and Weather.
7h A. M.	76°	78°	7°	E. moderate, cloudy.
12	78	78.25	7	Do. do. pretty clear.
3 P. M.	78	78	7	Do. do. do.
6	77	77.5	7	Do. do. do.
8	77	—	7	Do. do. do.

March 4. S. Lat. 27° 55′, E. Long. 50° 7′.

	Air.	Water.	Hygr.	Wind and Weather.
7h A. M.	77°	77°	4°	E. moderate, pretty clear.
10	78.5	77	5.5	Do. do. do.
12	79.5	77.5	7	Do. do. do.
3 P. M.	78.5	77.5	6.5	E. NE. do. slightly overcast.
6	78	77	4	E. by N. do. pretty clear.
9	78	76.5	3	E. NE. do. overcast.

The night was squally, with much swell. At 9h P. M. there was some appearance of dew, every thing being moist.

This is owing to the deliquescence of salt, with more or less of which every thing on the deck of a ship is impregnated. A dry glass tumbler when exposed remained dry.

March 5. S. Lat. 28° 47′, E. Long. 46° 40′.

	Air.	Water.	Hygr.	Wind and Weather.
7h A. M.	78°	77°.75	3°	NE. fresh, rather cloudy, much swell.
10	80	76.5	4	N. NE, do. do. do.
12	79	76.5	3	N. by E. do. overcast, do.
3 P. M.	79	76.5	3	N. by E. do. pretty clear, do.
6	78	76	3.5	NE. hard, partially overcast, do.
8	77	77	3	Do, do. do.

The night was squally and rainy.

March 6. S. Lat. 29° 21′, E. Long. 45° 5′.

	Air.	Water.	Hygr.	Wind and Weather.
6½h A. M.	75°	77°	3°	W. hard, overcast, much swell.
10	77	77	4	Do. do. do. do.
12	77.5	77	5	W. SW. do. do. do.
3 P. M.	76	77	3	SW. fresh, partially overcast, do.
6	76	77	3	W. SW. moderate, cloudy, do.
9	76	—	4	S. SE. gentle, rather cloudy, do.

The night was moderate.

March 7. S. Lat. 28° 47′, E. Long. 43° 56′.

	Air.	Water.	Hygr.	Wind and Weather.
7h A. M.	76°	77°.5	6°	S. by W. gentle, pretty clear, swell subsiding.
10	77	78	7	SW. do. rather cloudy.
12	77.5	78.5	8	SW. do. pretty clear.

From the temperature of the water I was led to infer, that the ship was in a current from the north; but, from a comparison of the observations and dead reckoning, it appeared, on the contrary, that, during the last two days, the ship was in a current setting to the north. There is, consequently, a difficulty in accounting for the high temperature of the sea in this case. This current may, therefore, be an eddy of the great south current flowing through the Mozambique Channel. Perhaps it may flow round the Belliqueux Bank.

3h P. M.	76°.5	78°.5	6°	SW. by W. moderate, cloudy.
6	76	78	6	SW. fresh, pretty clear.
9	76	77.5	6	Do. do. cloudy.

The night was moderate. We tacked twice during the night, being apprehensive of running upon the Hagus rocks, described by Captain Wilson, in S. Lat. 28° 20′, and 42° 13′ E. Long.

March 8. S. Lat. 29° 17′, E. Long. 42° 5′.

	Air.	Water.	Hygr.	Wind and Weather.
7h A. M.	75°	77°.5	8°	SW. gentle, cloudy.
10	77	75	7	S. do. do.
12	76	77	7	S. moist, pretty clear.

According to Captain Stewart, we have been, since yesterday, in a current of no great strength, setting a little to the west and south. At 10h A. M. when the temperature of the sea was 75°, we were probably crossing the southern extremity of the Belliqueux shoal. No change appeared in the colour of the water, and consequently the depth must have been considerable.

	Air.	Water.	Hygr.	Wind and Weather.
3h A. M.	75°.5	77°.	6°	S. moderate, pretty clear.
6	74.5	75	5.5	Do. do. do.
9	74	—	6	Do. do. do.

The night was fine. In the evening I saw three different meteors, or shooting stars, of considerable apparent magnitude, and great brilliancy. They appeared suddenly, and shot in different directions. The two largest seemed about the size of Venus.

March 9. S. Lat. 29° 38′, E. Long. 39° 26′.

	Air.	Water.	Hygr.	Wind and Weather.
7h A. M.	73°	77°.5	4°	S. fresh, overcast, rainy.
10	75	76.5	7	Do. do. overcast.
12	75	77	8	Do. do. pretty clear.

The Captain infers, from his reckoning, that we have been in a current setting towards the NE. though the contrary would appear to be the case, from the occasional high temperature of the sea. The effect may be owing to a counter-current or eddy.

	Air.	Water.	Hygr.	Wind and Weather.
3h P. M.	74°.5	77°	7°.5	S. fresh, pretty clear.
6	73	77.5	6.5	Do. do. do.
9	74	77	8	Do. gentle, do.

The night was fine.

March 10. S. Lat. 30° 51′, E. Long. 37° 12′.

	Air.	Water.	Hygr.	Wind and Weather.
6h A. M.	75°	78°	9°	E. gentle, cloudy.
10	77	77.5	9	Do. do. pretty clear.
12	78	77.5	9	E. by S. do. rather cloudy.

According to Captain Stewart, the current during the last twenty-four hours has been setting towards the SW. Many flying fish were observed yesterday and this morning. Numbers of black petrels were seen yesterday, and a very dark albatross this morning, which is the first we have observed.

	Air.	Water.	Hygr.	Wind and Weather.
3h P. M.	77°	77°	7°	E.SE. gentle, pretty clear.
6	75.5	76	6	SE. do. do.
9	75.5	—	5.5	S. by E. do. do.

The night was fine.

March 11. S. Lat. 31° 54′, E. Long. 34° 42′.

	Air.	Water.	Hygr.	Wind and Weather.
7h A. M.	76°	77°	6°	S. by E. gentle, pretty clear.
10	78	77.5	8	Do. do. do.
12	78.5	77.5	9	Do. do. clear.
3 P. M.	77	75	6	E. by S. moderate do.
6	75.5	75.5	4	Do. do. do.
9	75.5	—	4	Do. do. do.

The night was fine.

An albatross was seen this morning, and several flying-fish. The captain had never before seen this fish in so high a latitude.

March 12. S. Lat. 32° 50′, E. Long. 32° 26′.

	Air.	Water.	Hygr.	Wind and Weather.
6½h A. M.	75°	75°.5	2°	E. by S. moderate, clear.
10	77	75.5	4	Do. do. do.
12	77.5	75	3.5	E. by N. do. do.
3 P. M.	77	76	4	Do. do. rather cloudy.
6	77	76	2	Do. do. rather cloudy.
9	76	76	2	Do. do. clear.

The night was rather fine. There was no dew, though there was an appearance of it, as formerly mentioned on the 4th of March; a dry glass, when exposed, remaining dry.

During the last two days we have been in a current setting about W.SW.

March 13. S. Lat. 33° 41′, E. Long. 29° 16′.

	Air.	Water.	Hygr.	Wind and Weather.
$6\frac{1}{2}^{h}$ A. M.	76°	76°	3°	E.NE. fresh, hazy at horizon, heavy swell,
10	77	75.5	5	NE. do. do.
12	78	75	4	NE. do. do.
3 P. M.	79	77.5	4.5	NE. do. do.
6	77	77	4	E.NE. do. do.
8	77	74	4	Do. overcast, lightning,
9	—	75	—	NW. by W. do. do.

At night, when the lead was heaved, no bottom was discovered at 95 fathoms. According to our reckoning we were off Algoa Bay, and at 8^{h} P. M. at the edge of the bank, which the temperature of the water seemed to indicate. Between 8 and 9 o'clock we steered more to the south, and consequently came into deeper water, which was also indicated by the rise of the thermometer.

The night was squally and the wind contrary. In the evening, and during the night, there was a good deal of lightning, but no thunder was heard. Had the atmosphere been clear, we expected to have seen land in the evening.

March 14. S. Lat. D.R. 34° 34′, E. Long. 27° 20′.

	Air.	Water.	Hygr.	Wind and Weather.
$6\frac{1}{2}^{h}$ A. M.	76°	77°	2°	NW. by W. fresh, hazy below, cloudy above.
10	76.5	76.5	2	Do. do. do.
12	73	75	4	W. by N. do. overcast after rain.
4 P. M.	72	75.5	3	SW. by W. moderate, cloudy.
6	73	75	4	Do. do.
8	73	75	4	S.SE. do. do.

The night was cloudy and the wind moderate.

March 15. S. Lat. 35° 41′, E. Long. 24° 18′.

	Air.	Water.	Hygr.	Wind and Weather.
6^{h} A. M.	67°	76°	4°	S.SE. moderate, cloudy.
8	68	75.5	4	Do. do. do.
10	68	76	5.5	Do. do. do.
12	68	76.5	6.5	Do. do. do.
2 P. M.	68	76	6	SE. by S. do. overcast.
4	68	75.5	6.5	SE. do. do.
6	67.5	75	4.5	Do. do. do.
8	68	72	4.5	Do. do. do.
10	68	69	2	Do. do. do.
12	—	69	—	

The night was unpleasant, with some rain.

The current, during the last two days, has been strong, and has set about S.SW.

Though the thermometer is not below 68°, we feel so disagreeably cold that I am obliged to write wrapped up in a boat cloak, and yet do not feel warm.

The remarkable change in the temperature of the sea between 6 and 10 P. M. seems to show that we are on the bank of Lagullas, and confirms the accuracy of our reckoning. It is in situations of this kind that the thermometer promises to be particularly useful in navigation. It will, no doubt, indicate a bank, even when the bottom is too deep to be ascertained by sounding, and it is far from improbable that it may become an excellent substitute for the lead, the use of which is attended with so many inconveniences at sea. If the temperature of the water, for instance, on different parts of the bank, and at different seasons, were once well ascertained, a ship on her voyage to or from India, and not intending to touch at the Cape, would not require to use the lead when supposed to be on the bank of the Lagullas, but might ascertain the fact without delay or trouble, by the thermometer, and make a fresh departure from the bank with confidence.

The sea was very luminous, and the swell heavy. Many porpoises and many birds were seen in the course of the afternoon.

March 16. S. Lat. 35° 27′, E. Long. 20° 20′.

	Air.	Water.	Hygr.	Wind and Weather.
2h A. M.	—	68°	—	— —
4	—	68	—	— —
6	67°	69.5	2	SE. moderate, overcast.
8	70	69.5	3	SE. by E. gentle, do. after rain.
10	71	70	4	E. by N. do. do.
12	72	70	5	NE. by E. moderate, partial sunshine.
2 P. M.	72	70	5	E. do. cloudy.
4	71	70.5	4.5	E.SE. do.
6	67	57	2	Do. do. pretty clear, overcast.
8	63	57	2	Do. do. do.

The night was fine, the air very cold, and the horizon hazy.

At 6h P. M. the water was greenish, and the Lagullas about 10 miles off.

At 12h P. M. the lead was thrown out, and the bottom found at about 70 fathoms.

The current has carried us a good deal to the SW. and I suspect it must have acted most powerfully between 12 and 6 P. M. We are now steering for Point Lagullas.

Many albatrosses and several gannets were seen this morning. The appearance of the latter bird is considered as a proof of being on the bank.

March 17. S. Lat. E. Long.

	Air.	Water.	Hygr.	Wind and Weather.
1½h A. M.	63°.5	60°	2°	E. moderate, clear overhead.
6	65	60	2.5	SE. do. do. Cape of Good Hope about 8 miles off.
8	63	52.5	2	Do. moderate, about 3 miles from land.
10	65	51	4	Do. about 8 miles from Chapman's Point.
12	72	54	9	Hardly 1 mile from shore, under Lion's Head.
5 P. M.	72	52	8	Do.

About 5h P. M. the ship anchored in Table Bay, about 1½ mile from land, and in about seven fathoms of water.

ART. X.—*Account of a Map of Upper Laos, or the Territory of the Lowa Shan.* By FRANCIS HAMILTON, M. D. F. R. S. and F. A. S. London and Edinburgh. Communicated by the Author.

THE accompanying map (PLATE II.) has been reduced from the original drawing given to me by the slave of the heir-apparent of the kingdom of Ava, who has been mentioned, (*Phil. Journ.* ii. 89.) It represents the territory, which, in 1795, was in the possession of the Prince of Upper Laos, or of the Lowa Shan, but by no means the whole territory which at times has belonged to that people or its princes, and which is represented in the general map by the same person, (*Phil. Journ.* ii.) as I have endeavoured to show in treating of Zænmæ, (*Phil. Journ.* x. 65.) I then stated, that probably 16,000 square British miles, which at one time had belonged to Upper Laos, had been separated from it; and this alienated portion comprehended all the country on both sides of the Mækhaun, Mækhoup, and Mæpræn rivers. Nothing, therefore, remained then to the Prince of Upper Laos, but the territory on the Mæghue, and from thence to the Saluæn river. This accordingly forms the western boundary of Upper Laos, although Mr. Arrowsmith has brought it through the centre of the country.

The principality of Upper Laos, therefore, in 1795, extended from about Lat. 24° 05′ N. where the Saluæn leaves China, to about 21° 50′ N. where I suppose the Mæghue joins the Mæpræn, or principal branch of the river of Siam. In Arrowsmith's map, this is represented by a small branch joining the Maygue (as he writes it) on the east, and the name Maygue is extended down to Siam, in place of ending at the junction, as it ought to have done. The junction, besides, he brings too far south; as from the maps of Zænmæ, as well as the accompanying one, it is evidently at or near the frontier; the Mæghue not appearing in the maps of Zænmæ, nor the Mæpræn in that of the Lowa Shan. The principality, in its reduced state, extends about 135 geographical miles (60 to a degree) from north to south; and at the capital may be 75 miles wide, but towards the north it is much contracted, and its area does not probably exceed 3000 square British miles, or one-third of its original extent. Such a great diminution of territory was probably owing to the Lowa Shan having given provisions to the Chinese army, in the dispute with the Mranmas about the mines at Boduæn, and to their having refused to pay tribute in the reign of Zhænbrushæn.

The northern boundary of Upper Laos is formed by the territory of the Independent, or Wild Lowas, probably the Lolos of the Chinese; and this tribe in all probability occupies all the adjacent parts of the Chinese empire, which extends also along the eastern boundary, until we reach those parts of Laos which have been given to Zænmæ. The southern boundary is Zænmæ, and the western is the Saluæn.

Kiaintoun, the present capital, is about 30 or 40 miles from the southern end of the territory; and in place of being on the Saluæn, as represented by Mr. Arrowsmith, is about half-way between the eastern and western boundaries. In the sacred dialect, it is called Kemalatain. Leng, the former capital of the principality, was situated in the territory which has been alienated. There still, however, remain, besides the capital, twelve governments or cities marked in the map by squares; while the places marked by circles are Ruas or dependent towns. All these governments seem placed near the frontier, which is very mountainous; but there would appear to be an extensive plain around the capital, and towards the Mæghue on the north-east, and on the Mrænlo towards the north and west. This last small river runs through the centre of the country; but no connexion between it and any other is mentioned: it seems to rise in one cluster of hills, and to terminate in another. There are, in warm climates especially, many similar rivers; but from such a rude draught, it would not be safe to conclude that the Mrænlo is lost either by evaporation, which is not likely in a country so well supplied with rain, or by sinking into a cavern. It may very possibly be a branch of the Saluen. Mr. Arrowsmith, indeed, seems to have confounded it with that river, and therefore brought the Saluen through the middle of Upper Laos, as I have already mentioned. Even among the northern mountains an extensive flat of rice ground is laid down between Læhlu and M. Lue; so that, on the whole, the country is probably fertile, which will account for so many towns in so small an extent.

With respect to the scale, we have seven days' journey for the distance between the extreme towns; and allowing each of these to be 10 miles from the frontier, and the whole length to be 135 geographical miles, we shall have about 16 of these miles direct distance for a day's journey on lines of a considerable length. This, however, is probably too much, and could not be applied to the lateral distances.

Art. XI.—*Notice of Experiments on a Variation in the Rates of Chronometers, with the Density of the Medium in which they are placed.* By George Harvey, Esq. F.R.S.E. Plymouth.

In a series of interesting experiments on chronometers, Mr. Harvey has lately been led to the important discovery, that the density of the medium in which a chronometer is placed, has a sensible influence on its rate, *in most cases producing an acceleration when the density is diminished, or a retardation when the density is increased.* In a few timekeepers he has found the reverse to take place, viz. *a decrease of rate from diminished density, and an increase from increased density*, but the former appears to be the most general effect. Mr. Harvey has proved this to be the case, by an extensive course of experiments, and in which he has subjected many chronometers to pressures, from half an inch of mercury to 75 inches; and in all cases he has found, that if a timekeeper *gained* by *increasing* the density, it *lost* by *diminishing* it, and *vice versâ*. A difference of density, denoted by an inch of quicksilver, is sufficient to produce in many chronometers a visible alteration of rate.

We have been favoured with a few of Mr. Harvey's results, which are as follow,

A pocket chronometer, which possessed a steady rate of +1″.6, under the ordinary circumstances of the atmosphere, had its rate increased to +6″.2, when the density of the air was diminished to a quantity represented by 20 inches of quicksilver; and, on afterwards placing it in air, of a density denoted by 10 inches of mercury, a farther increase of its rate to +11″.6 took place. On restoring the timekeeper to the ordinary circumstances of the atmosphere, its rate returned to +2″.1.

In another set of experiments, with the same chronometer, Mr. Harvey placed it in a condenser, under an atmospheric pressure of 45 inches, when its rate changed to —4″.4; and on increasing the density of the air to a quantity denoted by 60 inches of mercury, the daily variation farther declined to —8″.2; and a nearly proportional declension was obtained when the pressure was increased to 75 inches of quicksilver.

In another remarkable experiment, Mr. Harvey found that when the rate of a chronometer was +23″.5, under a receiver, having its air exhausted to a quantity denoted by half an inch of mercury, the rate was altered to —17″.2, when the air was increased to a density corresponding to 75 inches of quicksilver; the rate of the time-keeper, under the ordinary circumstances of atmospheric pressure, being +4″.7.

Mr. Harvey has, we understand, drawn from this discovery several important conclusions. For example, that a chronometer constructed in London, nearly on the level of the sea, would undergo an alteration of rate, from difference of atmospheric pressure alone, if transported to Geneva, to Madrid, to Mexico, or any other place, situated much above the level of the place where it was constructed.

The whole of the interesting results obtained in this enquiry are about to be laid before the Royal Society.

ART. XII.—*On the Solution of Copper in Ammonia, and on the Oxidation of Copper plates.* By JOHN MACCULLOCH, M.D. F.R.S. F.L.S. and M.G.S. &c. Communicated by the Author.

IT is an unaccountable omission of chemists, not to have observed that copper is soluble in ammonia; I mean, of course, in the metallic state. This solution takes place rapidly in the heat at which the water of ammonia boils. The water is decomposed during the process, for the purpose of oxidating the metal, and hydrogen is obtained.

This fact may be turned to use in the arts. Gold trinkets, such as chains, are often made of a very inferior alloy; and, in this country I believe, they are never better than eighteen carat gold. They of course require to be coloured, to use the jeweller's term. This is done by dissolving the copper of the alloy to a certain depth on the surface; so that, after this operation, the metal is in fact gilded, nothing but pure gold being visible. The coat of pure gold is thus so slight, that it easily wears off in use; so that the operation of cleaning, (as it is supposed to be by the owners,) requires to be frequently performed, and this is done by a fresh process of solution, or colouring.

The method used by the artists is the application of a mixture of neutral salt, intended to disengage nitric acid, with the assistance of heat. In whatever manner, however, this is managed, there is much gold also dissolved in the operation; so much indeed, that where much work of this nature is performed, the quantity of metal rescued from the solutions amounts to a very considerable quantity annually. Artists are accused of doing this with fraudulent views; with what truth I shall not pretend to say. Whatever the fact may be as to this, a few repetitions of the colouring process are sufficient to destroy the finer kinds of workmanship, to the great regret of our ladies.

Boiling in ammonia is a safe substitute for this pernicious process, as it dissolves the copper from the alloy, and leaves, in the same manner, a gilded or yellow surface. It has the advantage that it can be performed by any one, without the necessity of employing an artist.

The oxidation of copperplates is a matter of very great importance in the arts; nor are the printers aware of the injury which these sustain in consequence of it. It is usual in all great and expensive works, not to print more impressions at once than are required for the present demand, when the plates are laid aside till they are again wanted. Thus they are often kept for many years; while, after each operation, they acquire an iridescent oxidated surface, which is removed by the hand of the operator in the first inking. A scale is thus repeatedly removed from the plate, to the great injury of all the finer lines; producing bad impressions, and, together with the ordinary injury from the hand and the chalk, at length rendering it what is technically called rotten and useless.

The mere operation of inking must, in time, wear out any plate, even in the most careful hands; but this evil would be diminished by preventing the oxidation in question; which, in some cases, produces a far thicker crust than would be imagined, and as, in itself, sufficient to be a cause of very serious injury to the distances and fainter parts.

This evil might be diminished by printing more impressions at one time; but, where it is necessary to lay the plate aside, it might be entirely prevented by varnishing. For this purpose, common lac varnish is easily applied; and it can be removed, when requisite, by spirit of wine. The varnish of caoutchouc might also be used for the same purpose, but I know not that it is more convenient.

ART. XIII.—*On the Accomodation of the Eye to Different Distances.* By DAVID BREWSTER, LL. D. F. R. S. London, and Sec. R. S. Edinburgh. *

THERE is no part of the physiology of the eye which has excited more discussion than the power by which it accommodates itself to different distances. Although the most distinguished philosophers have contributed their optical skill, and the most acute anatomists their anatomical knowledge, yet, notwithstanding all this combination of science, the subject is as little understood at the present moment as it was in the days of Kepler, who first attempted the solution of the problem.

In recollecting the great names which have appeared in this controversy, it is impossible to approach the subject without much diffidence; but this feeling is, in some degree, removed, when we observe the utter discordance of the results, and their absolute incompatibility with the principles of optics, on the one hand, and the structure of the eye on the other.

Kepler was of opinion, that, in the process of adjustment, the eye was lengthened and shortened by the action of the ciliary processes. Descartes supposed, that the crystalline lens changed its form, by the muscularity of its own fibres. Huygens conceived, that the crystalline approached the cornea, by the pressure of the external muscles, or that the lens might be made more convex by the same action. M. de la Hire maintained, that the whole effect was produced solely and immediately by the enlargement and diminution of the pupil; and Dr. Porterfield thought, that the crystalline lens was drawn backwards and forwards by the action of the ciliary processes.

These different opinions have been revived by more recent physiologists. The opinion of Huygens was modified and defended by Dr. Monro. Mr. Walker has endeavoured to support the hypothesis of De la Hire, and Dr. Thomas

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* This paper was read before the Royal Society of Edinburgh on the 15th Dec. 1823.

Young has revived the opinion of Descartes, and sustained it with all the ingenuity which might have been expected from his profound knowledge of Optics and Physiology. In the elaborate memoir which he has composed on this subject, he has attempted to show, that the fibres of the crystalline are muscular, and, that the accommodation of the eye to remote objects is effected by the increase of convexity which that muscularity produces. In estimating the value of this hypothesis, it is important to state, what Dr. Knox informs me is confirmed by all his observations, directed especially to this point, that the crystalline lens floats loosely within its capsule, in the *liquor morgagni*, and that no anatomist has traced to it any nervous filaments.

In stating this objection we have taken it for granted, that the fibres, if they were muscular, are capable of increasing the convexity of the lens; but, when we consider the singular constitution of this part of the eye, and especially the fact, that the fibres are lines of contrary flexure, we venture to say, that no sagacity is capable of predicting the actual effect which would arise from their contraction. One thing only is certain, that the fibres of the outer laminæ would, in the process of contraction, press upon those of the inner laminæ, and destroy that compound gradation of density,* by which the aberration of sphericity is so finely corrected.

In studying the changes which take place when the eye adjusts itself to different distances, it has been long ago observed that the pupil contracts in viewing near objects, and dilates in observing distant ones. By combining this admitted fact with a fallacious experiment, De la Hire maintained, that the diminution of the pupil united upon the retina the rays of near and luminous objects by excluding unnecessary light, and cutting off the extreme rays of the pencils, while the enlargement of the pupil gave distinctness to distant objects by admitting a greater quantity of light into the eye.

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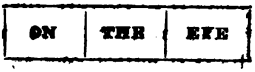
* The compound gradation of density here alluded to has not hitherto been noticed in the crystalline lenses of animals. I have described it fully in a paper on the Human Eye, which was read before the Royal Society of Edinburgh on the 2d Dec. 1822, and will soon be published.

Although succeeding philosophers saw the general fallacy of this principle, yet, in their eagerness to renounce it, they fell under the influence of another no less incompatible with observation. It was universally allowed that the pupil varied its size in the adaptation of the eye to different distances, but this was considered as merely a concomitant effect, depending entirely on the varying intensity of the light of the objects to which the eye was directed. In the dilatation of the pupil by the action of Belladonna, Dr. Wells and other physiologists remarked, that the eye lost its power of seeing near objects; but this instructive fact, though of primary importance in the inquiry, was not pursued as it ought to have been; and the phenomenon which it presented was supposed to be consistent with every theory of adjustment, as those parts of the eye on which this adjustment depended might be supposed to be paralysed along with the iris during the action of the Belladonna.

In this state of the subject I was desirous of discovering the cause, and estimating the influence of this variation of the pupil. For this purpose I selected a near and a distant object equally illuminated, and directed a young person to look attentively and successively at both. The result of this experiment was, that the pupil *contracted* in viewing the *near* object, and *dilated* in viewing the distant one, so that the variation which it experienced could not have been produced by the stimulus of light. In order to ascertain what took place at the two limits of the range of distinct vision, I took a piece of paper, as shown in the annexed figure, and wrote upon it the three words, ON THE EYE. Having placed a fold of white paper behind the word THE, and two folds behind the word EYE, I fixed the piece of paper at one end of a square draw-tube, and placed my eye at the other end, so that I could read all the words by the transmitted light of a candle held behind the paper. The word ON was most luminous; the word THE was less luminous, and the word EYE still less so. I now brought the paper as near my eye as possible, so that I could see the word ON with perfect distinctness. When this was done, no exertion whatever could enable me to read the word THE, and still less the word



EYE. I then looked at them through a small aperture which, upon De la Hire's principle, ought to have given me distinct vision, but it produced the opposite effect, and increased the indistinctness of the last two words. By making the words THE and EYE as luminous as the word ON, or by bringing *another* candle near the eye, so as to force the pupil to contract still farther, they could be read with the greatest facility.

From this experiment we may draw *three* important inferences.

1*st*, That the contraction of the pupil which accompanies the adjustment of the eye to near objects does not produce distinct vision, by the diminution of the aperture, but by some other action which accompanies it.

2*d*, That the eye adjusts itself to near objects by two actions, one of which is *voluntary*, depending wholly on the will; and the other *involuntary*, depending on the stimulus of light.

3*d*, That when the voluntary power of adjustment fails, the adjustment may still be effected by the involuntary stimulus of light.

It now became an interesting inquiry to ascertain what takes place at the other extremity of the range of distinct vision, namely, in viewing distant objects. If the contraction of the pupil is a necessary accompaniment of the action which adjusts the eye to *near* objects, the *dilatation* of the pupil ought to have the same relation to the action which adjusts it to remote ones.

As objects must cease to be visible when the stimulus of light is withdrawn to such an extent, as to produce a great dilatation of the pupil, it becomes somewhat difficult to show that this dilatation is essential to the vision of remote objects. The experiments with the Belladonna incontestibly prove, that when the pupil is widened to its utmost extent, the eye loses the power of adjustment to near objects, and has its power of observing distant ones improved and extended; but, as the whole eye may be considered as in a paralysed state during the experiment, it is necessary to employ another method of observation. It occurred to me, that, if the dilated condition of the pupil was essential to remote vision, all short-sighted persons ought to have their sphere of vision extended in the evening. I accordingly found, upon inquiry, that this was the case to a great degree, and that several short-sighted persons could count the six stars of the Pleiades, though they were unable to see objects distinctly at a moderate distance during the day. The most superficial observer, indeed, must have remarked the distinctness of remote objects in the evening, especially in that state of the heavens when all adjacent objects are lost in obscurity, and when the eye recognises only the precise and well-defined outlines of the trees and mountains that are projected against the horizontal sky.

This remarkable effect of the dilatation of the pupil may be deduced from the converse process of observation. If we look at distant objects while the light of the sun is reflected upon the eye, the voluntary power of adjustment is still capable of dilating the pupil so as to produce distinct vision; but the tendency of the iris to contract under the involuntary stimulus of light, produces such a painful sensation in the eye as to leave no doubt, even if the dilatations were not visible, that the iris was under the influence of two opposite actions.

Having thus stated the most palpable arguments which may be adduced on this subject, it appears to me impossible to avoid the conclusion, that the power of adjusting the eye depends on the mechanism which contracts and dilates the pupil; and, since this adjustment is independent of the variation of its aperture, it must be effected by the parts which are in immediate contact with the base of the iris. At this point, however, observation and experiment fail; but, though we may never be able to point out the precise manner in which the action excited at the base of the iris produces the adjustment, yet, by excluding all other possible hypotheses, it may not be difficult to fix upon the true one, and establish it by that degree of evidence which is deemed satisfactory in other physiological inquiries.

The mechanism at the base of the iris may be conceived to produce the adjustment in four ways. *1st*, By elongating the eye during the contraction of the pupil. *2d*, By increasing the convexity of the cornea. *3d*, By altering the convexity of the capsule of the lens; and, *4th*, By increasing the distance of the crystalline lens from the retina. The first two of these modes of adjustment are excluded by the direct observations of Mr. Ramsden and Sir Everard Home, which prove, that neither the convexity of the cornea, nor the length of the eye, is altered during adjustment. The 3d mode, depending on a supposed alteration in the curvature of the capsule of the lens, cannot produce the effect, because the *liquor morgagni*, in which the lens floats, has nearly the same refractive power as the aqueous humour, and therefore no change in the curvature of a membrane which separates them, could produce a perceptible deviation in the transmitted rays.

The last hypothesis, therefore, remains as the only probable one, namely, the removal of the lens from the retina by the contraction of the pupil, the eye being adjusted to objects at the remote limit of its range when in a state of perfect repose.

Independently of this train of argument, the opinion we have been supporting derives much countenance from various well-ascertained facts. The loss of the power of adjustment by the extraction of the lens, proves that this part of the eye is essential to the process, and many physiologists have considered a motion of the lens as the most probable change that could take place in the interior of the eye. The want of muscularity, however, in the ciliary processes, induced many of them to abandon this opinion, while those who continued to maintain it, never supposed that it might be effected through the agency of the iris by the combination of a voluntary and an involuntary action.

The anatomy of the base of the iris has been hitherto so imperfectly understood, that it is not easy to point out the precise manner in which the muscular action of this membrane may be propagated to the lens; but these parts have been accurately examined, in reference to this inquiry, by Dr. Knox; and the Society will be able to judge from the details which he has given in a separate paper, whether or not they present any objection to the views which have now been explained.

The preceding experiments and observations have an immediate application to those imperfections of vision to which the eye is exposed as an optical instrument. The range of distinct vision is necessarily affected by any diminution in the voluntary or involuntary powers of adjustment, and so extensive, sometimes, is the influence of such a change, that the eye may be regarded as blind for objects at particular distances, and under particular degrees of illumination. The cure of these apparently serious, and often alarming imperfections, is often extremely simple, by merely increasing or diminishing the involuntary stimulus of light, or by an alteration in the range of vision by means of coloured glasses, a purpose to which, so far as I know, they have never yet been applied.

Art. XIV.—*Mean of Twelve Months Meteorological Observations, in the Years* 1822-3. By His Excellency Sir Thomas Brisbane, K. C. B. F. R. S. &c. &c.

1822.	Thermometer.		Barometer.		Hygrometer.		Rain.
		Fahr.		Inches.			
MAY.	Highest	72°	Highest	30.23			
	Lowest	42	Lowest	29.50			
	Mean	60	Mean	29.87			
JUNE.	Highest	67	Highest	30.20			
	Lowest	26	Lowest	29.55			
	Mean	53.3	Mean	30.09			
JULY.	Highest	68	Highest	30.25			
	Lowest	27	Lowest	29.50			
	Mean	51.5	Mean	29.96			
AUGUST.	Highest	77	Highest	30.20			
	Lowest	35	Lowest	29.54			
	Mean	56.5	Mean	29.80			
SEPT.	Highest	93	Highest	30.20	Highest	60	Rain 3.413 inches.
	Lowest	36	Lowest	29.70	Lowest	26	
	Mean	62	Mean	29.92	Mean	44.5	
OCTOBER.	Highest	106	Highest	30.23	Highest	87	Rain 0.516.
	Lowest	42	Lowest	29.72	Lowest	40	
	Mean	68	Mean	30.02	Mean	51.5	
NOVEMBER.	Highest	99	Highest	30.35	Highest	80	Rain 5.235.
	Lowest	48	Lowest	29.53	Lowest	24	
	Mean	72	Mean	29.88	Mean	50	
DECEMBER.	Highest	102	Highest	30.30	Highest	77	Rain 1.092.
	Lowest	47	Lowest	29.60	Lowest	35	
	Mean	74	Mean	30.05	Mean	53.5	

TABLE—*continued.*

1823.	Thermometer.		Barometer.		Hygrometer.		Rain.
		Fahr.		Inches.			
JANUARY.	Highest	106°	Highest	30.30	Highest	100	Rain 5.261.
	Lowest	52	Lowest	29.78	Lowest	24	
	Mean	73	Mean	30.12	Mean	49	
FEBRUARY.	Highest	97	Highest	30.25	Highest	78	Rain 6.660.
	Lowest	49.5	Lowest	29.62	Lowest	24	
	Mean	68.5	Mean	29.91	Mean	40	
MARCH.	Highest	98	Highest	30·45	Highest	48	Rain 7.215.
	Lowest	49.5	Lowest	29.77	Lowest	12	
	Mean	60	Mean	30.15	Mean	33	
APRIL.	Highest	74	Highest	30.44	Highest	74	Rain 0.556.
	Lowest	40	Lowest	29.60	Lowest	22	
	Mean	59	Mean	30.05	Mean	44	

The zero of the hygrometer is the greatest damp, and 100° the greatest drought: The elevation of the barometer is 62 feet above the level of the sea.

	Fahr.
The Annual Mean Temperature of *the air* at Paramatta, as deduced from these observations, is	63°.16
The Mean Temperature of *the air* at Paramatta, as calculated by Dr. Brewster's formula, for two poles of maximum cold, is about	63°
The Mean Temperature of *the earth* at Paramatta, as determined by Sir Thomas Brisbane, in 1822, by thermometers placed deep in the earth, was about	61°.5

This difference of about 1½° between the temperature of *the air* and that of *the earth*, is nearly the same as what takes place in corresponding latitudes in the northern hemisphere.

	Inches.
The mean height of the barometer for 1822-3 is	30.00
The quantity of rain	29.948
Annual range of the barometer	0.95
Greatest degree of heat	106° Fahr.
Greatest degree of cold	26°
Annual range of the thermometer	80°
Mean state of the hygrometer	45°.7
Annual range of the hygrometer	67°

ART. XV.—*Observations on the Measurement of Heights by the Barometer.* By CHARLES BABBAGE, Esq. F.R.S. F.R.S.E. and Secretary to the Astronomical Society. In a Letter to Dr. Brewster.

MY DEAR SIR,

I MENTIONED to you, a long time since, that I had some ideas relative to the measurement of heights by the barometer, which it might be interesting either to verify or disprove. As it is very uncertain when I may find myself in situations favourable to the trials I propose, I should be very happy if, through your means, any other person were induced to undertake the investigation.

It is generally admitted by those who have determined altitudes by the aid of this instrument, that when the lower observation is made in a narrow or deep valley, situated at the foot of a mountain range, the upper observation being made on an exposed summit, the elevation of the mountain thus determined falls short of its true height. This effect has sometimes been ascribed to a current of air cooled by the snow on the summit, and acting with the velocity due to its descent on the quicksilver in the basin of the instrument at the lower station. Other reasons have been assigned; but, without determining the real cause, it seems possible, from its observed effects, to deduce an approximate measure. I have remarked, in a variety of instances, that when I have made an observation of the barometer and thermometer in a valley at the bottom of a mountain, and again, several other observations in ascending it, until I reached the summit, when the lowest and highest observations have been computed, they have generally fallen short of the sums of the heights, as deduced from a calculation of the height, from the first to the second station, from the second to the third, and so on to the summit. In a height of about 1500 feet, measured in the valley of Lauterbrunnen, with considerable care, I found,

The direct height, ...	1485.7 feet.
The sum of two heights, there being only one intermediate station, ...	1490.9
Diff. . . .	5.2

On the Simplon, on a height of 4850 feet, I found, by employing four stations, a difference of 11.8 feet, but the circumstances here were not very favourable to the trial. At Chamouni, in the neighbourhood of Mont Blanc, on a height of 5300 feet, I found a difference of 76 feet by three stations.

I mention these cases, not as sufficient to found a theory upon, nor as having been made with care enough to verify one when contrived; but merely as a few of those facts which called my own attention to that subject, and as affording a reasonable ground of further inquiry.

The algebraical formula which represents the height of any station above any other, by observations of the barometer and thermometer, contains within it certain constant quantities which must be ascertained by observations for each particular place: of these, the mean temperature of the air, and the difference in length of the column of mercury in the barometer, at the two stations, are the most essential. There are, however, others of less amount, which must not in all cases be omitted; and the system of inquiry which I would propose is, to assume some law of action for these descending currents, or for any other presumed cause; and, having introduced this new consideration into the formula, to determine the constants belonging to it, by the various observations made in ascending to the summit. Thus, if one additional constant were admitted, it would be necessary to make one intermediate station; if more constants appeared, the observations must be more numerous. The equation for determining these constants would be deduced from the condition, that the sum of the heights of all the steps, from the bottom to the top, should be equal to the total computed height from the lowest and highest observations.

In order to verify this theory, it would be desirable to select a situation where the lower station is in a deep valley, overlooked by lofty mountains, on whose sides other stations are to be chosen, and a series of observations made simultaneously. The altitude of these stations should, if possible, be measured trigonometrically.

It would probably be found necessary to try several hypothetical assumptions relative to the action of this unknown cause; but if any traveller should be induced to make observations, with sufficient care, on altitudes of from six to twelve thousand feet, these would form most valuable data to those whose speculations might otherwise be of minor utility, from the want of the necessary facts with which to compare them.

Before I terminate this letter, I shall make one other suggestion, relative to the detached thermometer, in order to ascertain the temperature of the air at any station, influenced as little as possible by radiation from surrounding objects. I would recommend that it be inclosed in a small cylindrical case, open at both ends, and perforated with a few holes, and that, when suspended by a string, it be whirled rapidly about. The current of the air which passes over it will probably have a greater effect in communicating to it the temperature of the air than can be counterbalanced by radiation from the neighbouring objects.—I remain, My Dear Sir,

faithfully yours,

Devonshire Street, Portland Place, C. BABBAGE.
May 5, 1822.

ART. XVI.—*Tables of the Variation of the Magnetic Needle in different parts of the Globe.*

THE following Table from Hansteen is given by itself, on account of the great number of new observations which have been made in the part of the world to which it refers. These new observations, which we have printed in the form of supplementary tables, comprehend the observations of Captain Ross, Captain Franklin, Captain Parry, Captain Hall, and Mr. Foster.

TABLE.—*Containing the Variation of the Needle, as observed in America and the adjacent Islands.*

NAMES OF PLACES.	Year of Observation.	Magnetic Variation.	NAMES OF PLACES.	Year of Observation.	Magnetic Variation.
Acapulco,	1744	3° 0′ E.	Bear Island,	1596	13° 0′ E.
Albany Fort,	1736	23 0 W.		1610	13 30
Antigua Island,	1774	17 0 W.	Beverley,	1781	7 4 W.
	1727	4 28 E.	Barbadoes, Carlisle Bay,	1726	4 24 E.
	1761	4 31 W.		1761	3 47
Augustin Cape,	1670	5 30 E.	Bastimento's Isle,	1726	7 48

TABLE—*continued.*

NAMES OF PLACES.	Year of Observation.	Magnetic Variation.
Boston,	1708	9° 0′ W.
	1741	7 30
Button Isle,	1615	24 0
	1730	39 0
Buenos Ayres,	1708	15 32 E.
Bahia, Brasil,	1708	4 30
Cambridge,	1708	9 0 W.
	1742	8 0
	1761	7 14
	1763	7 0
	1780	7 2
	1783	6 52
Cape Cathivas,	1726	7 24 E.
Carthagena,	1705	7 12
	1726	6 50
St. Croix Island,	1783	3 20
St. Christopher's, Basseterre,	1726	4 10
Cuba,		
Pau de Matanzas,	1726	4 24
Havannah,	1732	4 30
Cayenne Island,	1672	11 0
	1682	5 30
Conception,	1709	10 20
Coquimbo,	1700	8 32
Curaçoa,	1704	6 40
Cumana,	1799	4 14
Chesapeake Bay,	1732	4 58 W.
Cod Bay,	1789	6 45
Cape Christian, Greenland,	1605	12 15
St. Catharine's Isl.	1712	12 0 E.
	1785	12 0
	1804	7 51
Cape Corientes,	1684	4 28
Discovery Harbour,	1792	21 30
Desolation Sound,	1792	19 16
St. Diego, California,	1792	11 0
Descado Island,	1726	3 27
Domingo,		
Cape François,	1772	5 20
	1776	5 30
	1783	5 32
Alta Vela Island,	1728	6 2
Frio, Cape,	1670	12 10
Fernando Naronha,	1610	8 10
Florida, Cape,	1726	3 26
Fuego, Terra del,		
Christmas Sound,	1774	24 43
Good Success Bay,	1769	24 9
Godthaab, Greenland,	1784	50 30 W.
	1787	51 21
Guadaloupe,	1726	3 22 E.
Hermit Island,	1707	20° 0′ E.
Juan Fernandez,	1767	11 0
Jamaica,		
Portland Point,	1726	6 2
Port Royal,	1726	4 31
Black River,	1732	6 2
Jamba Point,	1726	6 20
Lima,	1709	6 15
Mexico,	1769	5 30
Martinique,	1682	4 10
	1704	6 10
	1760	5 41
Marie Galante Island,	1726	3 40
St. Martha, Cape,	1704	7 6
Masafuera Island,	1765	9 36
	1767	10 24
	1795	9 15
Mendocino, Cape,	1693	2 0
	1786	14 24
Moose Fort, Hudson's Bay,	1774	17 0 W.
Musquitoe Cove, Greenland,	1776	50 36
Monterrey,	1795	12 22 E.
Montserrat,	1760	5 32
Newfoundland,		
Fort St. Pierre,	1772	19 15 W.
Nutka,	1778	19 45
	1792	18 22 E.
Norton Sound,	1778	25 45
Norriton,	1770	3 8 W.
Porto Bello,	1704	7 25 E.
Pisco,	1707	7 0
Paraibo,	1698	5 35
Quito,	1742	8 30
Quebec,	1649	16 0 W.
	1686	15 30
Rio Janeiro,	1768	7 34 E.
	1787	6 12
Resolution Island,	1615	24 6 W.
Savage Island,	1615	27 30
Smith's Sound,	1616	57 0
Santiago, Chili,	1794	14 28 E.
Sebalt Island,	1683	23 10
	1707	23 0
Spitzbergen,		
Bell Sound,	1613	13 11 W.
Cross Rheid,	1596	16 0
Horn Sound,	1610	16 0
	1613	12 37
Magdalen Sound,	1614	25 0
Poopy Bay,	1613	15 21

TABLE I.—*Continued.*

NAMES OF PLACES.	Year of Observation.	Magnetic Variation.	NAMES OF PLACES.	Year of Observation.	Magnetic Variation.
Read, Beach,	1596	16° 0′ W.	Pr. Wales' Fort,	1725	21° 0′ W.
Vogelsang,	1773	20 38		1742	17 0
Unalashka Samganoodha Harbour,	1778	19 59 E.		1769	9 41
			Ylo, Peru,	1710	6 38 E.
Vera Cruz,	1769	6 40	York, New,	1686	8 45
	1776.	7 30		1723	7 20
Valparaiso,	1709	9 30		1750	6 20
	1795	14 49		1755	5 0?
Valdivia,	1670	8 60		1789	4 20

SUPPLEMENTARY TABLE I.—*Containing the Variation of the Needle, as observed by Captain Ross out of the Ship's Attraction, in Baffin's Bay, in* 1818.

West Long.	North Lat.	Magnetic Variation.	West Long.	North Lat.	Magnetic Variation.
57° 36′	73° 23′	80° 1′ W.	64° 43′	75° 50′	91° 33′ W.
57 56	74 1	80 30	65 40	75 55	92 44
61 5	75 32	88 13	72 54	76 30	103 41
63 0	75 51	87 50	77 1	76 33	107 56
64 41	75 59	91 17	78 48	76 8	109 1
64 45	75 50	90 18	77 57	70 35	86 33

SUPPLEMENTARY TABLE II.—*Containing the Variation of the Needle, as observed by Captain Parry in* 1819 *and* 1820.

West Long.	North Lat.	Magnetic Variation.	West Long.	North Lat.	Magnetic Variation.
48° 9′	59° 49′	48° 38′ W.	105° 54′	75° 3′	158° 4′ E.
61 59	63 44	60 20	107 3	74 58	151 30
62 8	63 29	60 56	110 49	74 47½	127 49
59 12	70 29	74 39	110 36	75 35	135 4
59 56	72 0	80 55	111 57	75 5	123 48
60 12	73 3	82 37	112 53	74 24	110 56
77 22	73 31	108 47	113 48	74 26	106 7
89 41	72 45	118 16	112 11	74 27	114 35
88 18	73 33	115 37	71 18	71 16	91 29
91 47	74 40	128 58	68 37	70 22	80 59
103 44	75 9	165 50 E.			

SUPPLEMENTARY TABLE III.—*Containing the Magnetic Variation observed in His Majesty's Ship, Conway, Captain Basil Hall, in* 1820, 1821, *and* 1822.[*]

NAMES OF PLACES.	West Long.	South Lat.	Magnetic Variation.	NAMES OF PLACES.	West Long.	South Lat.	Magnetic Variation.
Valparaiso,	71° 31′	33° 2′	14° 43′ E.	Pt. Pescadores,	73° 33′	16° 15′	11° 20′ E.
Mocha Island,	73 46	38 19	19 34	Callao Castle,	77 6	— —	10 34
Arauco,	73 13	37 14	18 22	Ancon,	— —	11 46	10 25
Talcuhuana,	73 0	36 43	15 30	Huacho,	— —	— —	9 36
Bay of Coquimbo,	71 8	29 54	14 0	Payta,	— —	— —	9 0
				Guayquil,	79 40	2 12	9 5
Guasco,	71 9	28 27	13 30	Galapagos,	90 21	0 32	8 20
Arica,	70 13	18 29	10 25	Panama,	— —	— —	7 0
Point Coles,	71 20	17 42	10 18	Acapulco,	99 54	— —	8 40
Mollendo,	71 54	17 2	11 5	San Blas,	105 17	21 32	8 40

ART. XVII.—*Historical Account of Discoveries respecting the Double Refraction and Polarisation of Light.*

THE papers which we have already published on this subject, comprehend what may be called the first period of its history, during which no discovery of any marked importance succeeded the original inquiries of Bartholinus, and the fine generalisations of Huygens. A new era, however, now commenced; and the subject of double refraction was destined to take an elevated place among the most interesting branches of natural philosophy.

PERIOD IV.—*Discoveries of Malus.*

In the year 1808, the Institute of France proposed as the subject of a prize, to be adjudged in 1810, the following question:

To give a Mathematical Theory, verified by experiment, of the Double Refraction which Light experiences when transmitted through different Crystallized Bodies.

Two or three memoirs competed for this prize; but only one of them was considered by the Institute as meriting their special approbation. This memoir, which was crowned in 1810, bore the name of E. L. Malus, Member of the Egyptian Institute and Colonel of the Imperial Corps of Engineers. This distinguished officer had accompanied the expedition to Egypt under Bonaparte, and had returned to his native land, worn out with the insalubrity of the climate, and with the sufferings of a campaign, in which the horrors of famine and defeat were combined. In the calm seclusion of a scientific life, he expected to reinvigorate his exhausted frame; but he had miscalculated the effects of mental labour on the animal functions, and probably found, when it was too late, that the unrestrained efforts of the mind were no less hurtful than the severest privations or the most overstrained exertions to which the bodily frame can be exposed.

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[*] From Captain Basil Hall's *Journal, written on the Coasts of Peru*, &c. vol. ii. app. p. 59.

SECT. I.—*Malus's Discovery of the Polarisation of Light by Reflexion.*

The prize offered by the Institute induced Malus to enter with zeal on the study of double refraction. He measured all the phenomena, as exhibited through natural and artificial faces of calcareous spar, variously inclined to the axis of the rhomb, and having observed the wonderful coincidence of his measures with the law of Huygens, he was soon convinced that this law was an accurate expression of the phenomena. During these experiments, which were made in the Rue des Enfers, in Paris, he accidentally directed a prism of calcareous spar to the windows of the Luxembourg, which were then illuminated by the setting sun, and he was surprised to observe, that one of the doubly refracted images of the windows vanished alternately during the revolution of the prism. Perplexed with this unexpected fact, he at first ascribed it to the agency of the atmosphere, but this hasty opinion was speedily corrected, and he at last found that the light had acquired this new property by reflexion from the panes of glass. Hence, he was immediately led to his great discovery, *that when a pencil of light*, RS, Fig. 3, Plate I. *is reflected by the surface of water* AB *at an angle* RPS *of* 52° 45′ *with the perpendicular* SP, *the reflected ray* ST *has all the characters of one of the pencils produced by the double refraction of a regular crystal.*

"This pencil ST," says Malus, "is no longer susceptible, like direct light, to divide itself constantly into two pencils in passing through a rhomboid of Iceland spar; and as, in the case of light, which has already experienced the action of a first crystal, this faculty depends on the angle contained by the principal sections of the two crystals, so, in the present case, it depends on the angle comprehended between the plane of reflexion and that of the principal section of the crystal which receives the reflected light. In general, in all phenomena of this kind, the plane of reflexion RPST replaces the plane of the principal section of the first crystal.

"If we receive the reflected ray ST on any crystal whatever that has the property of doubling images, and whose principal section is parallel to the plane of reflexion RST, it will not be divided into two pencils, as if it had been a pencil of direct light, but it will be refracted entirely according to the ordinary law, as if the crystal had lost its property of duobling images. If, on the contrary, the principal section of the crystal is perpendicular to the plane of reflexion RST, the reflected ray ST will be refracted entirely according to the extraordinary law of refraction. In all intermediate positions it will be divided into two pencils, according to the same law, and in the same proportion as if it had acquired its new character by the influence of double refraction.

"The ray ST reflected by the surface AB of the fluid, has, therefore, in this circumstance, all the characters of an *ordinary* ray produced by the refraction of a crystal whose principal section is *parallel* to the plane of reflexion RST, or of an *extraordinary* ray formed by a crystal, whose principal section is perpendicular to the same plane.

"In order to analyze this phenomenon completely, I have placed vertically the principal section of a crystal; and, after having divided a luminous ray by double refraction, I received the two pencils on the surface of water, and at an angle of 52° 45′. The ordinary ray was partly refracted, and partly reflected, as if it had been a pencil of direct light, but the extraordinary ray penetrated entirely the water, and not one of its particles escaped refraction. On the contrary, when the principal section of the crystal was perpendicular to the plane of incidence, the extraordinary ray produced only a partial reflexion, and the ordinary ray was refracted entirely.

"The phenomena now described, as taking place with water, are the same with all other transparent bodies, whether solid or fluid; but the angle RST, at which light experiences this modification, is variable for each, and is in general greater in bodies that refract light most. Within and beyond this limit, a part of the rays is more or less modified, and in a manner analogous to what takes place between two crystals whose principal sections are neither parallel nor rectangular.

"In order to observe the principal phenomenon without measuring it exactly, we must place a lighted taper before the diaphanous body, or the vessel containing the liquid which is to be used for the experiment. We must then examine, through a prism of Iceland crystal, the image of the flame reflected by the surface of the body or of the liquid. This image will generally be seen double; but in turning the crystal slowly round the visual ray as an axis, one of the images will be seen to grow fainter, while the other increases in intensity. Beyond a certain limit, the first begins to increase in intensity at the expense of the second. We must then seize, as nearly as possible, the point where the intensity of the light of one of the images is at its *minimum*, and move the reflecting surface to a greater or a less distance from the taper, till we obtain an angle of incidence at which this image entirely disappears. This distance being determined, we shall perceive, by turning the crystal round slowly, that one of the two images vanishes alternately at every quarter of a revolution.

"The phenomenon which we have observed in light reflected at a particular angle, PST, at the surface of transparent bodies, takes place at a different angle in the pencils reflected at the inner or second surface of the same bodies; and the sine of the first angle is to the sine of the second angle in the ratio of the sines of incidence and refraction. Thus, if we suppose the face of incidence AB, Fig. 4, Plate I. and the face of emergence CD parallel, and the angle of incidence RSP, such as the phenomenon requires, the ray S σ T reflected at the second surface will be modified in the same manner as the ray reflected at the first surface; and if the incident ray RS has been previously polarised, or is such that all its particles escape partial reflexion at the first surface AB, they will also escape it at the second CD.

"If we examine the light arising from the partial reflexion of bodies, such as black marble, ebony, &c. we likewise find an angle at which light receives the modification above described.

"Polished metallic substances are the only ones which do not appear to be susceptible of producing this phenomenon completely; possibly because the partial light which has received this modification is confounded with the rays which proceed from total reflexion." *

Malus now proceeded to examine the appearances which take place when a ray, polarised by reflexion from one glass, is again reflected from a second plate of glass, having a rotatory motion round the polarised ray, and forming with it a constant angle.

Let a ray RS, Fig. 3, proceeding from the sun, supposed to be due south, be polarised by reflexion from the surface AB, and let it be received upon a second reflecting surface CD, so that PTV, the angle of reflexion from CD, may be equal to PST, the angle of reflexion from AB. Let the plate CD be now supposed to revolve round the ray ST, preserving its inclination to the ray, viz. STC, invariable; then, in the case represented in the figure, where the second plate CD faces the *South*, and where the plane of the second reflexion from CD is parallel to the plane of the first reflexion from AB, the ray ST will suffer partial reflexion in the direction TV, as if it had been common light. If the plate is now made to revolve round ST in different azimuths, so that its face begins to turn to the *East*, the intensity of the reflected pencil TV will gradually diminish; and when it has performed a revolution of 90°, or has its face turned towards the *East*, the pencil TV will *disappear entirely, not a single ray of it suffering partial reflexion*, in which case the plane of reflexion from CD is at right angles to the plane of reflexion from AB. By continuing to turn the plate, the ray TV will re-appear, and will gradually increase in intensity till the plate has turned round

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* *Théorie de la Double Refraction de la Lumière*, p. 222. Paris, 1810.

180° from the beginning of its motion; in which case the plane of reflexion from CD will be again parallel to the plane of reflexion from AB, and the reflected ray TV will then be a maximum, as it was at the commencement of its motion. By continuing to turn the plate, the reflected ray will again *disappear* at an azimuth of 270°, and will regain its maximum upon returning to 360°, or 0°, the point from which it set out.

It is obvious, from Fig. 1, that, in the two positions of the plate CD, when the intensity of the ray TV is a maximum, viz. at 0°, and 180° of azimuth, the inclination of the two plates of glass is $180 - (90° - 54° 35' + 90° - 54° 35') = 70° 50'$ in the first case, and that they are parallel in the second case.

In the azimuth of 90° and 270°, where the ray TV entirely disappears, the inclination of the plates will be represented by $\text{Cos.}\ \varphi = \text{Cos.}^2\ \theta$ where θ is the angle of polarisation, in this case 54° 35′, and φ the inclination of the plates, which will be found to be 70° 22′ 35″.

Hence it follows, that if we take two plates of glass, AB, CD, inclined to one another at a fixed angle AOD of 70° 22′ 35″, and conceive a line drawn from the first plate to the second, so as to make with both an angle = BST, CTS, of 35° 25′, and whose projection upon both will form, with their common intersection, an angle of 30° 5′ 30″, every ray reflected by one of the plates of glass parallel to this line will suffer no reflexion from the second, but will wholly penetrate it. On both sides of these angles this effect will come to be produced, but the farther we go from the limits in either direction, the more will the quantity of the reflected light increase.

The variation of the intensity of the reflected light in passing from the minimum to the maximum, may be represented, as Malus has shown, by supposing it proportional to the square of the cosine of the angle of azimuth, or to any even power of the cosine. Thus, if a is the angle of azimuth, which the plane of the second reflexion makes with the plane of the first, I the maximum intensity of the reflected pencil TV, and P the intensity of the pencil corresponding to any azimuth a, then $P = I\ \text{Cos.}^2\ a$, or $P = I\ \text{Cos.}^4\ a$. By taking a successively equal to 0°, 90°, 180°, 270°, it will be seen that either of these formulæ represents the different phenomena which have been above explained. Thus, if $a = 0°$, then $\text{Cos.}\ a = 1$, $\text{Cos.}^2\ a$, or $\text{Cos.}^4\ a = 1$, and $P = 1$, that is, the reflected pencil is at its maximum; and if $a = 90°$, then $\text{Cos. } a = 0$, and $\text{Cos.}^2 a = 0$, or $\text{Cos.}^4 a = 0$, and $P = \theta$, that is, the reflected pencil will entirely disappear.

ART. XVIII.—*Observations on the General Anatomy of the Gymnotus Electricus, the Electric Eel of America; and on the Philosophical Anatomy of the Electric Organs.*[*] By ROBERT KNOX, M. D. F. R. S. E. &c. &c. Communicated by the Author.

THE objects I had in view, in examining (after dissections by Hunter and Cuvier)[†] a specimen of the *Gymnotus Electricus* were, 1*st*, to reduce, if possible, the singular organs possessed by the electrical animals to some corresponding or analogous tissue common to all animals, or at least to that class to which they naturally belong, and, 2*dly*, to obtain farther information relative to my favourite pursuit, the comparative anatomy of the nerves, which I hoped I should find by the dissection of an animal, in which a portion of that system of organs was carried to its highest degree of developement, giving rise to the phenomena by which the analogies subsisting betwixt the efficient cause of muscular contraction and those universally acting imponderable fluids, known under a variety of names, such as electricity, galvanism, &c. were proved unequivocally to exist.

My distinguished friend, the Chevalier Geoffroy St. Hilaire, examined, at an early period of life, the electrical organs of the *Silurus electricus*, the electric Eel of the Nile; and he concluded, from his dissections, performed, it is true, under circumstances highly unfavourable for such pursuits,[‡] that the electric organs of these, and of other similar animals, might be considered as organs of sensation. Pursuing these principles, laid down by himself, and by M. de Blainville, than whom, perhaps, no more accurate anatomist lives, I have ventured to class the electrical organs with the muscular system, and to consider them as organs of motion; that the unknown fluid, expended in exciting the muscular fibre to contraction, is, in these organs of the *Gymnotus*, collected for the purpose of being discharged from the surface of the animals, for its defence and protection.

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[*] The Paper, of which this is an abstract, will be read before the Royal Society of Edinburgh, on the 6th of June, 1824.

[†] Those who have not at their command the *Philosophical Transactions*, or the *Annales du Musum*, in which the papers of Hunter and Geoffroy are printed, will find drawings and descriptions of the electric organs of fishes in the Article ELECTRICITY, in the *Edinburgh Encyclopædia*, Vol. VIII. p. 472—480.

[‡] If my memory does not fail me, this gentleman, who has, since that period, risen to the highest rank as a zoologist, examined the *Silurus* amidst the miseries and privations of a siege; for at that time Alexandria was invested by the British arms; so difficult is it to repress the ardour of a truly philosophic and scientific mind.

The arrangements adopted by eminent writers on comparative anatomy prove that they deem these organs as defying classification with others: in the "Leçons d'Anatomie Comparée," they are described near the termination of the work with the organs of peculiar secretion; in the "Principes d'Anatomie Comparée," they are viewed as an appendage of the integuments, which, at first sight, seems rather an anatomical than physiological arrangement, though no doubt, if we adopt certain other views of the distinguished author of that work, this view would, in some measure prove correct. In the excellent little manual of M. Blumenbach, these organs are considered along with the brain and nerves; but as nearly all the organs of any animal might be viewed in this way, it must be evident that the exact place the electric organs ought to hold, had not been determined, nor their precise nature agreed on.

But, in whatever way these partly theoretical views may be received, I trust I have added a few additional facts to the anatomy of the animal, which may become important in more philosophic hands; and which may serve as an apology for the more speculative parts of the memoir, of which it is meant to give, in this place, only a very brief abstract.

The first part of the memoir is occupied chiefly with the strictly anatomical details,—a part of the subject which had been already examined with great care, and nearly exhausted, by Hunter and Cuvier; and these truly great men had left, as was to be expected, but little to be done by others. The electric Eel examined by me, was $19\frac{1}{10}$ inches in length, and about two where broadest. Its greatest circumference was $3\frac{3}{4}$ inches. In shape it resembles an eel; but the head and jaws are much broader, and do not taper as in the latter. From the anterior extremity to the anus is 1$\frac{1}{10}$th of an inch, and from this to the extremity of the tail was found to be nearly 18 inches; hence may be understood the vast preponderance of the part of the animal destined to inclose the electric organs, over that containing the thoracic and abdominal viscera. The position, however, of the orifice of the rectum in the *Gymnotus* is not a true measure of the capacity of the abdominal cavity, which extends considerably beyond it towards the tail; the actual length of the great electric organs was found to be 15¼ inches; their ratio then, to the total length, is as 15.5 to 19.

The organization of the greater electric organs themselves is sufficiently simple. On their dermal aspect are found thirty-one longitudinal and nearly parallel white lines, the terminating edges of so many laminæ, which, in this way, intersect the organ, proceeding from the outer to the inner surface, and terminating in the enveloping and central lamina, dividing the greater organs from each other. In order to understand the nature and distribution of the second substance entering into the composition of the electric organs, we must return to the external surface of these organs. We now perceive that the longitudinal septa are intersected at right angles by plates of a much softer texture, proceeding across the organ, placed excessively close to each other, but yet apparently inclosing spaces of exceedingly small capacities.[*]

We may either consider the plates I now speak of, as extending from one side of the organ to the other, or as constituting so many distinct plates, intercepted by the white longitudinal laminæ. Very careful and repeated observations convinced me, that the first of these opinions is the most correct, so that we must view each transverse plate as equalling in length the breadth of the electric organ to which it belongs, and of a depth necessarily varying with that of the organ itself. As it was important to ascertain the correctness of this view by every way in my power, I requested Dr. Brewster to submit small sections of the organ to a powerful microscope.

[*] The number of plates occupying the space of an inch, was found to be about 240, which is remarkable for being precisely the number counted by Mr. Hunter in a much larger fish.

The result proved the accuracy of the common glass I had used, confirming the opinion, that the transverse soft plates of the electric organ, intersecting the longitudinal ones, are not interrupted in their course by these longitudinal and vertical laminæ, but are continuous, passing quite across the organ, and must be viewed as a number of plates whose length is not to be measured by the distance of the longitudinal septa from each other, but rather by the whole breadth of the organ.

The electric organs are supplied by nerves communicating with the spinal marrow only; which, when first seen lying immediately below the great lateral nerve, on their escape from the vertebral column, are observed to be remarkably large and numerous. As the whole of the organ was not exposed, it is impossible for me to state the precise number of the nerves proceeding to the electric organs, but it seemed to be in the proportion of fifteen nervous branches to every inch of the organ. They varied in size according to the corresponding bulk of the organ at that particular point in which they entered; they are flat like the ciliary nerves in the mammalia, constituting one mass at leaving the vertebræ; but dividing generally, if not uniformly, into five distinct branches before entering the organ itself. Having given off nervous twigs, equalling at least the longitudinal septa in number, the larger branches pass through the fatty matter separating the greater from the smaller electric organs, and are distributed upon these apparently in the same way as upon the larger ones. I do not believe that any branch of the sympathetic nerves is sent to the electric organs.

(To be continued.)

Art. XIX.—*On the Crystalline Forms and Properties of several Salts.* By William Haidinger, Esq. F.R.S.E. Communicated by the Author.

I undertook the examination of the forms, and of some of the other natural-historical properties of the following hitherto undescribed, or but imperfectly described salts, at the request of Dr. Brewster; who was so kind as to communicate to me those crystals to which the descriptions refer, and to add the characters relative to their refraction and the number of optical axes.

1. *Sulphate of Ammonia and Chromium.*

Form, tessular; crystals observed in the shape of a regular octahedron, PLATE III. Fig. 4. *Cleavage*, octahedron imperfect. *Fracture*, conchoidal. *Surface* of the octahedrons rather uneven.

Lustre, vitreous. *Double Refraction*, none. *Colour*, between violet-blue and columbine-red, deep and beautiful; the colour inclines more to red where the specimens are thickest. *Streak*, very pale lavender blue, nearly white. *Feebly translucent.*

Hardness, = 2.0 . . . 2.25 *). *Sectile.* *Taste*, sweetish and saline, very faint.

Observations.—The crystals of this salt were sent to Dr. Brewster, by Mr. Cooper of Paradise Row, Lambeth.

2. *Molybdate of Ammonia.*

Form, hemi-prismatic. Fundamental form, a scalene four-sided pyramid, PLATE III. Fig. 26, in which the ratio of the lines AP : MB : MC : MP = $a : b : c : d$ is equal to that of 20 : 45 : 45.5 : 1. The inclination of the axis, or the angle PAM is = 2° 52′, the inclination

$$\text{of } P \text{ upon } P = 133^\circ\ 18' = \frac{\text{P}}{2},$$

$$\text{of } P' \text{ upon } P' = 140^\circ\ 50' = -\frac{\text{P}}{2}.$$

The simple forms observed in the combination, Fig. 27, of which Fig. 28 is a projection upon a plane parallel to the face c, are the following, together with the angles at which they meet contiguous to a plane passing through n, o, p, and n′.

$$\frac{\text{P}}{2}\,(P) = 133^\circ\ 18'. \qquad (\bar{\text{P}}\text{r} + \infty)^3\,(a) = 127^\circ\ 26'.$$

$$-\frac{(\frac{4}{3}\bar{\text{P}} - 2)}{2}\,(e) = 166^\circ\ 28'. \qquad (\bar{\text{P}} + \infty)^4\,(b) = 152^\circ\ 16'.$$

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* In estimating the comparative degrees of hardness of salts according to the scale of Mohs, where 2 expresses the hardness of Rock-salt, and 3 that of Calcareous spar, it will be found useful to interpolate the common Potash Alum as an intermediate degree, which is expressed by 2.5, so that the hardness of the Sulphate of Ammonia and Chromium being = 2.0 . . . 2.25, though superior to that of Rock-salt, is yet very little different from it.

$-\frac{(\bar{P}r-1)}{2}(f) = 159° 50'$. $-\frac{\bar{P}r}{2}(d) = 64° 5'$.

$-\frac{(\breve{P}r)^3}{2}(g) = 109° 10'$; $\breve{P}r + \infty (c)$.

The angle here given for $\frac{\bar{P}r}{2}$ is that which the face *d* includes with the axis of the form. The angle n′ p o is = 115° 55′; n o p = 111° 6′; o n p′ = 132° 59′.

Cleavage, highly perfect and easily obtained in the direction of $\breve{P}r + \infty$, that is to say, parallel to the face *o*. Traces parallel to *d*. *Fracture*, imperfect conchoidal. *Surface*, very deeply striated, parallel to the edges of combination with *c*; $\frac{P}{2}$ less so than all the other faces.

Double Refraction, two axes. *Lustre*, pearly upon the faces *c*, both of crystallization and of cleavage; vitreous upon the other faces of crystallization. *Colour*, pale verdigris-green, mountain-green. *Streak*, white. *Translucent*.

Hardness, = 2.0 ... 2.5. *Sectile*. *Taste*, saline, strong.

Observations.—The crystals of this interesting and beautiful substance, though of considerable size, and well pronounced, were so much disfigured by deep and numerous striæ, that the angles, as given above, may perhaps allow of a subsequent small correction, although the measurements, as far as the specimens would allow, have been taken with care by means of the reflective goniometer. At first sight the crystals of the Molybdate of Ammonia seem to possess a form nearly agreeing with that of native sulphur, which, however, appears not to be the case upon a more accurate examination. The crystallized variety to which the preceding description refers, was sent to Dr. Brewster by Professor Berzelius.

3, *Muriate of Barytes*.

Form, prismatic. *Fundamental form*, a scalene four-sided pyramid, Plate III. Fig. 29, P=131° 0′; 98° 10′; 101° 39′. The ratio of the three lines A M : B M : C M = *a* : *b* : *c* is = 1 : √2.32 : √0.93. Three of the observed combinations are represented in Figs. 30, 31, 32. Besides the fundamental one, they contain the following simple forms:—

$\breve{\mathrm{P}}\mathrm{r}\ (a) = 113^\circ\ 26'.$

$\breve{\mathrm{P}}\mathrm{r} + 1\ (b) = 74^\circ\ 32'.$

$\frac{3}{4}\,\breve{\mathrm{P}}\mathrm{r} + 2\ (c) = 53^\circ\ 50'.$

$\breve{\mathrm{P}}\mathrm{r} + \infty\ (d).$

$\bar{\mathrm{P}}\mathrm{r}\ (h) = 87^\circ\ 5'.$

$\mathrm{P} + \infty\ (g) = 115^\circ\ 19'.$

$(\breve{\mathrm{P}}\mathrm{r} + \infty)^3\ (f) = 76^\circ\ 36'.$

$(\breve{\mathrm{P}} + \infty)^3\ (e) = 55^\circ\ 40'.$

The angles of the horizontal prisms are those contiguous to the principal axis of the combination; the angles of the vertical prisms are those contiguous to the obtuse lateral solid angle of the fundamental pyramid.

Cleavage, $\breve{\mathrm{P}}\mathrm{r} + \infty$ perfect and easily obtained. There is also some indistinct cleavage in the directions of $\mathrm{P} - \infty$, $\bar{\mathrm{P}}\mathrm{r}$ and $\bar{\mathrm{P}}\mathrm{r} + \infty$. *Fracture*, conchoidal. *Surface*, in general smooth, $\breve{\mathrm{P}}\mathrm{r} + \infty$ sometimes striated parallel to the edges of combination with *a*, *b*, *c*, and with *e*, *f*, *g*.

Double refraction two axes. *Lustre* vitreous, inclining to pearly, particularly upon $\breve{\mathrm{P}}\mathrm{r} + \infty$. *Colour* and *streak* white. *Transparent*.

Hardness = 2.0 . . . 2.25. *Sectile*. *Taste* cooling and somewhat bitter.

Observations.—The crystals of Muriate of Barytes resemble very much those of Heavy-spar, both in respect to their form and their cleavage. They differ in their angles, as appears from the following comparison of some of their prisms.

	Heavy-Spar.	Muriate of Barytes.
$\breve{\mathrm{P}}\mathrm{r}$	= 105° 6′;	= 113 26′;
$\bar{\mathrm{P}}\mathrm{r}$	= 78° 18′;	= 87° 5′;
$(\breve{\mathrm{P}}\mathrm{r} + \infty)^3$	= 77° 27′;	= 76° 36′.

Count Bournon has given the first notice of the forms of salt, *Cat*, p, 187.

4. *Nitrate of Lead.*

Form tessular, The varieties most commonly observed are, the octahedron, Plate III. Fig. 4, and the octahedron in combination with the hexahedron, Fig. 33. There are likewise crystals like that represented in Fig. 34, where the additional faces *e* are derived from a pentagonal dodecahedron, similar to that of the hexahedral Iron-pyrites. The angle produced by the intersection of *e* and *e′* is = 126° 52′ 12″.

Cleavage not observable. *Fracture* perfect conchoidal, *Surface* of the octahedrons rather uneven.

Double refraction none. *Lustre* resinous, inclining to adamantine. *Colour* white, grayish or yellowish, and inclining to gray; varying according to the degrees of transparency. *Streak* white. *Translucent*, sometimes only at the edges.

Hardness = 2.5 . . . 2.75. *Sectile*. *Taste* sweetish and astringent, very strong.

Compound varieties. Regular composition very common, parallel to one of the faces of the octahedron, Fig. 5.

Observations.—Octahedral crystals of the Nitrate of Lead are mentioned by Count Bournon and by Mr. Brooke. It is the only species, besides the two well-known ones of hexahedral Iron-pyrites and hexahedral Cobalt-pyrites, where the faces of the pentagonal dodecahedron, marked *e*, *e′* in the figure, have ever been observed, if we except the crystals of Alum, obtained by M. Beudant, in allowing this salt to crystallize from muriatic acid, and noticed likewise by Count Bournon.

5. *Oxymuriate of Potash*.

Form hemi-prismatic. Plate III. Fig. 35, represents the result of cleavage, which is easily obtained in the three directions parallel to *P* and to *M*. Faces of crystallization are very often observed parallel to *P*, between which the crystals are commonly so much depressed that they appear in the shape of scaly particles. *Surface* of *P* striated parallel to its edges of combination with *M*, and also parallel to both the diagonals of the rhombic figure.

Double refraction, two axes. *Lustre* vitreous. *Colour* and *streak* white. *Transparent*.

Hardness = 1.5 . . . 2.0. Rather *brittle*. *Taste* cooling.

Compound varieties. Twin-crystals composed parallel to the face *P*, Fig. 35, very common.

Observations.—From a want of sufficiently distinct crystals, I have not been able to complete the examination of the forms of this substance, which, no doubt, will prove highly interesting. Some preliminary measurements have given the inclination of *P* upon *M* nearly = 106°, and of *M* upon *M* nearly = 104°, the face *P* being inclined upon the obtuse edge of the prism. This salt is mentioned in Count Bournon's *Catalogue*, p. 186.

(*To be continued*.)

Art. XX.—*Description of the Circular Segment Micrometer.* Communicated by the Author.

As the circular micrometer has now come into universal use, and has been employed by most of the distinguished continental astronomers in all their observations on comets, and in determining the differences of right ascension and declination of the stars that pass through the field of the telescope, I trust that any suggestion for the improvement upon such an instrument will be acceptable to the astronomical readers of the Edinburgh Journal.

In a late number of the Philosophical Magazine,[*] Mr. F. Baily has published an excellent paper on Circular Micrometers, and in the same number there has appeared a translation from Professor Schumacher's *Astronomische Nachrichten*, No. 43. of Frauenhofer's description of the different improvements which he has made upon the instrument.[†] I shall therefore suppose the reader to be acquainted with what has been previously done upon this subject, and proceed to describe the new micrometer which has been suggested to me by a perusal of these papers, and especially by the remark made by Frauenhofer, "that, for determining the relative place of two very near stars, for instance, a double star, there still remains a good deal to be wished for in the described micrometer."

In place of a complete circle fixed to the diaphragm of the telescope, I propose to use one or more circular segments, as shown in Plate I. Figs. 7, 8, and 9. In these figures, where AB is the diaphragm, the two segments C*m*D, C*n*D, turned and finished in the most accurate manner out of the same circle, are placed so as to intersect each other, either in the circumference of the diaphragm as in Fig. 7, or at two points within the diaphragm as in Fig. 8, or so as not to intersect at all as in Fig. 9. In all these cases the differences of right ascension and declination of two stars, whether they are very near each other, like double stars, or at a greater distance, may be obtained by not very complex formulæ, from their repeated immersions and emersions behind both the concave or both the convex sides, or behind one of the convex and one of the concave sides.

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[*] *Philosophical Magazine*, March 1821, vol. lxiii. p. 177.

[†] See the Scientific Intelligence of this number.

As the formulæ depend upon the radius of the circular segments, it is, of course, taken for granted that the astronomer can readily determine this element, either from the passage of an equatorial star across a diameter of the circle or by other means. When the segments are taken from the same circle, one of them may be made fully equal to a semicircumference of the circle, so that the determination of the radius becomes easy.

When the segments cross one another, as in Figs. 7 and 8, the circular edges may, by nice and flat turning, be brought into the same plane with more accuracy than two of the smallest wires intersecting each other in the field of view.[*]

Art. XXI.—*On the Passage of Basalt into Granite.* By Samuel Hibbert, M.D. F.R.S.E. and Secretary to the Society of Scottish Antiquaries, &c. &c. Communicated by the Author.

The circumstances under which basalt is found connected with granite, must necessarily form one of the most important of geological investigations. This interest has arisen from the alleged igneous origin of basalt having been considered as far less disputable than that which is assigned to granite. For several very valuable communications on this subject, we are, in a particular manner, indebted to Dr. MacCulloch, who, in his notice of many sites of rocks, illustrative of the junctions of basalt and granite, has adverted to the vicinity of Hillswick Ness, in Shetland. In the account which I published of the geology of this country, it appeared more doubtful to me than at present, whether any of its rocks afforded a perfect illustration of so interesting a circumstance; but the different view which I now entertain, arises from subsequent observations which I have made on the nature of trap-rocks in other districts, and from a re-examination of the very extensive collection of specimens that I have brought with me from the Shetland Islands.

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[*] Those who are desirous of studying the uses of the Circular Micrometer may consult Baron Zach's *Monatliche Correspondenz*, vols. xvii. xxiv. and xxvi. where Bessel's formulæ are given for almost every case; Santoni's *Elementi di Astronomia*, tom. i. p. 261; and Mr. F. Baily, in the *Philosophical Magazine*, vol. lxiii. p. 179.

It is not difficult to account for the great confusion that has long prevailed on the subject of trap-rocks in general, when we reflect, that the nomenclature of their different varieties depends upon the presence of such mutable ingredients as hornblende or augite, which by almost insensible gradations are so apt to pass into each other, as not unfrequently to possess a sort of intermediate character. The French distinction, therefore, of *diabase* and *dolerite*, is too frequently no less difficult to be made than that which is attempted by British geologists, when they speak of greenstone, of augite rocks, or of basalt. Another source of confusion arises from the endeavour to affix certain names to the different degrees of proportion in which hornblende and augite are severally united to felspar, and even upon their more or less intimate states of combination. As far, however, as I have yet been able to collect from the various descriptions which authors have given of what they actually mean by the term *Basalt*, it seems most generally applied to any intimate commixture of hornblende, or even of augite, with felspar, when the last-mentioned ingredient is found in a much smaller proportion than in that rock to which, in contradistinction, the name of greenstone is given. But, at the same time, the analysis of basalt indicates, that under this designation another variety may even be included, for it would appear, that the small proportion of felspar contained in it does not manifest the presence of potash, like some other varieties of this ingredient, but exclusively soda.

The basalt, which is the subject of the present paper, consisted of hornblende in an intimate state of union with a very small proportion of felspar. It is of a dark green colour, and possesses a structure which is minutely granular. The trap-rocks, of which it forms a part, extend from the island of Mickle Roe northwards to Roeness Voe, a distance of twelve miles, and are here from one to three broad. On the west of these trap-rocks is a considerable mass of granite, which may be twenty-four miles in the same northerly direction. This granite almost exclusively consists of the ingredients of quartz and felspar. I could find no mica in it.

The last characterized rocks of basalt which occur among the trap series of this district, are to be found in the vicinity of Hillswick Ness and near Mavis Grind, at which latter place they are contiguous to another granitic mass. But at each of these spots, their passage into granite may be observed. This transition I shall now describe. Not far from the junction, we may find interspersed through the basalt very minute particles of quartz. This is the first indication of an approaching change in the nature of the rock. In again tracing it still nearer the granite, we find the particles of quartz dispersed through the basalt becoming still more distinct, more numerous, and larger, an increase of magnitude even extending to every other description of particles. The rock may now be observed to consist of separate ingredients of quartz, hornblende, felspar, and greenstone; the latter substance (greenstone) being a homogeneous commixture of hornblende and felspar. Again, as we approach still nearer the granite, the disseminated portions of greenstone disappear, their place being supplied by an additional quantity of felspar and of quartz. The rock now consists of the three distinct ingredients of felspar, quartz, and hornblende. The last change which takes place results from the still increasing accumulation of quartz and felspar, and from the proportionate diminution of hornblende. The hornblende at length eventually disappears, and we have a well-characterized granite, consisting of the two ingredients of felspar and of quartz.

From this example, then, it would appear, that the transition of basalt into granite essentially depends upon the gradual development of quartz. At the same time, there is an increase of felspar, and there may also be a diminution or total disappearance of the hornblende.

Near Hillswick Ness, the passage of felspar-porphyry into granite may be likewise noticed. Some of the continental geologists who describe the transition, and who speak of felspar-porphyry as a "disguised granite," vaguely conceive that the change is effected by a mere increase of the size of its component particles. But it will be here seen, that the passage of felspar-porphyry into granite, not only depends upon the particles of the rock which undergoes the transition becoming larger, but (as in the case of basalt,) upon the gradual and distinct development of the ingredients of quartz.

I cannot conclude this account without recommending the examination of the trap-rocks in Shetland to the attentive examination of the geologist who may be induced to visit this remote part of the British dominions. There is an invasion of the granite to the north of Roeness Hill by a large dyke of trap, that sometimes attains a width of two or three hundred yards. Its ramifications are magnificently displayed in the steep declivities which bound the west coast of Northmavine.

Art. XXII.—*Description of two surfaces composed of Siliceous Filaments incapable of reflecting light, and produced by the fracture of a large crystal of Quartz.*[*] By David Brewster, LL. D. F. R. S. Lond. and Sec. R. S. Edinb.

The very remarkable specimen of Quartz which I propose to describe and exhibit to the Society belongs to the cabinet of the Marchioness of Huntly, who was so kind as to leave it with me for particular examination. The original crystal, of which it forms a part, was two inches and a quarter in diameter, and of a light smoky colour, but impervious to the light except in small pieces. It was broken up for the purposes of his profession by Mr. Sanderson, lapidary in Edinburgh; who remarked the blackness of the fracture, and laid it aside for the purpose of showing it to me.

At first sight, the absolute blackness of the separated surfaces seemed to me, as it did to every one, to be owing to a thin film of opaque and minutely divided matter that had insinuated itself into a fissure of the crystal; but this opinion was immediately overturned when I observed, that both surfaces were equally and uniformly black, and that they were also perfectly transparent by transmitted light.

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[*] Read before the Royal Society of Edinburgh, May 17, 1824.

Although I had now no doubt that the phenomenon was entirely of an optical nature, and that the blackness of the surfaces arose from their being composed of short and slender filaments of quartz, whose diameter was so exceedingly small, that they were incapable of reflecting a single ray of the strongest light, yet it became desirable to establish this curious fact by experimental evidence.

Having found that no detergent substance either removed or diminished the superficial blackness, I subjected the fragment to the action of cold and hot acids; but the surface continued unaltered by these operations. I now immersed the fragment in oil of Anise seeds, which approaches to Quartz in its refractive power, and upon examining the light reflected at the separating surfaces of the oil and the quartz, I found that the blackness disappeared, and that the fragment, whether seen by reflected or transmitted light, comported itself like any other piece of Quartz of the same translucency. Upon removing the oil from the surface, it resumed its original blackness; and the filamentous or velvety nature of the surface was rendered evident to the eye by the slight change of tint, which was produced by pressing the filaments to one side.

As the preceding experiments are sufficient to prove that the size of the minute filaments was less than the thickness of a thin plate of Quartz which lost the power of reflecting light, it became interesting to obtain an approximate measure of their magnitude. The thinnest substance ever observed is the aqueous film of the soap bubble previous to its bursting. Newton, however, remarked, that the film still reflected a faint image of the candle or of the sun. Hence its thickness must have corresponded nearly with what Newton calls the *beginning of black*, which appears in water at a thickness of the 750,000dth part of an inch. The tint, however, of the quartzy surface is of a much deeper character, and cannot exceed the *very black* of Newton's scale, which corresponds in *Quartz* to *one-third of the one-millionth part of an inch*, or to *one-fourth* of the thinnest part of the soap bubble.

If the two surfaces of Quartz had separated by filaments of a larger size, the colour of the filamentous surface might have been *red*, or *blue*, or *yellow*, or *green*; but, though such a structure would have been more dazzling to the eye, it would yet have been less wonderful than the one which has now been described.

In Mr. Allan's collection, Mr. Haidinger observed a group of Quartz crystals from Dauphiny, some of which were broken across, and exhibited a surface approximating, in its structure, to the one under consideration. As these crystals, however, were transparent, and admitted the light in all directions, the fractured surfaces never appeared black; but we have no doubt that the blackness of the surface would be seen if the crystals were surrounded with black wax, and if no other light were permitted to reach the eye but that which was incident on the filamentous surface.

In a large crystal of Amethyst with several fissures, I have observed, with a powerful microscope, a very remarkable configuration of the separated surfaces, which exhibits a series of brilliant superficial colours arising from the minute points of which the surface is formed. We may therefore expect to find in the fractures of Quartz the filaments of such a size as to display, in uniform tints, the most brilliant colours of the spectrum.

ART. XXIII.—*Sketch of the Characters of the Species of Mosses, belonging to the Genera Orthotrichum, (including Schlotheimia, Micromitrion and Ulota,) Glyphomitrion, and Zygodon.* By W. J. HOOKER, LL.D. F.R.S. &c. &c. Regius Professor of Botany in the University of Glasgow; and R. K. GREVILLE, LL.D. F.R.S.E. &c. &c. with three Plates. Communicated by the Authors.

IT being our intention, from time to time, to offer to the admirers of Mosses, memoirs of certain genera or families of this beautiful tribe, we have selected for the subject of the present paper, a class of individuals which has perhaps been of all others the least understood, and of which it has been our good fortune, through the liberality of our correspondents, as well as by our own personal investigations, to obtain a much larger number than we believe has fallen to the lot of other botanists to possess. To the descriptions we have added figures of such species (at least of those parts of them as afford the most essential characters,) as are either entirely new, or have been but imperfectly described.

In so anomalous a genus as *Orthotrichum*, we have found it scarcely possible to form an artificial character which shall completely include its genuine species, and exclude those not properly belonging to it, and it may be supposed by some, that we have increased this difficulty by not adopting the genera of *Schlotheimia* and *Micromitrion*. But the fact is, that their distinctive marks are founded upon circumstances which are not more at variance with those of the generally acknowledged *Orthotricha*, than many of those are among themselves. In several species that have been placed under those genera, the peristome, upon which their distinction should rest, is quite unknown, while, in habit, they preserve so perfect a similarity to the *Orthotricha*, as forbids, in our opinion, the separation from them. Indeed, a more entirely natural and beautiful genus than that of *Orthotrichum*, as it at present stands, can scarcely be found in the whole department of muscology.

ORTHOTRICHUM.

GEN. CHAR.—*Seta* terminalis. *Peristomium* simplex vel duplex; *dentibus* vel 8 trilineatis, vel 16 unilineatis per paria approximatis: ciliis 8 vel 16;* vel raro membrana erecta lacerata. *Columella* acuta. *Calyptra* mitriformis.

Genus naturalissimum, sed difficillime describendum, per totam fere orbem distributum. Plantæ perennes, in arboribus vel muris rupibusque provenientes, nunquam terrestres; cæspitosæ, e basi ramosæ, ramis plerumque in regionibus temperatis, e. gr. europæis, erectis; in tropicis, plerisque exoticis, repentibus, ramulis erectis. Folia magis minusve lanceolata, viridia vel fuscescentia, nervosa, siccitate stricta vel insigniter tortuosa, incurva, vel etiam recurva. Capsula foliis immersa, atque vix seta instructa, vel pedicellata, seta elongata semperque stricta, magis minusve ovata, oblonga vel pyriformis, lævis vel sulcata vel ad apicem solummodo lineis longitudinalibus impressa, fere plicata. Operculum plerum-

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* In O. perichætiale we have observed these ciliæ to be double.

que rostro longo stricto. Peristomium insigniter varians, plerumque colore pallido, dentibus ciliisque articulatis, articulis æqualibus vel torulosis, hæ ciliæ nunc e lateribus nunc e membrana interna ortæ. Columella non raro valde exserta, acuta, nunquam, ut in splachno, capitata. Calyptra plerumque magna campanulata vel oblonga, sæpissime striata multifida, glabra, vel pilis rigidis articulatis obsita, nunc basi quadrifida, nunc erosa.

A. PERISTOMIO SIMPLICI.

* *Capsula immersa.*

1. O. *cupulatum*, foliis ovato-lanceolatis erecto-patentibus siccitate erectis strictis rigidis, capsula subsessile per totam longitudinem sulcata, calyptra pilosiuscula, demum omnino glabra.

O. cupulatum. Hoffm. Germ. v. 2. p. 26. Schwaegr. Suppl. t. 55. Hooker and Tayl. Musc. Brit. p. 72. t. 21.

O. anomalum, Smith Fl. Brit. p. 1267. Engl. Bot. t. 1423.

O. nudum, Smith, Fl. Brit. p. 1268. Engl. Bot. t. 1325.

O. strangulatum, Beauv. Æthéog. p. 81. Schwaegr. Suppl. v. 2. p. 33. t. 54.

Hab. Rocks and trunks of trees; Europe. New York, North America, Dr. Torrey.

Plant of a rigid habit, dark colour, and scarcely exceeding an inch in height; the leaves remarkably straight, obtuse, with a strong and reddish nerve. Capsule deeply furrowed, and calyptra scarcely at all hairy. By an examination of authentic specimens of P. de Beauvois' *O. strangulatum*, we are satisfied that it is nothing more than *O. cupulatum*; and Schwaegrichen's figure of it, above quoted, differs only in its showing a slight contraction near the middle of the capsule, which is probably caused by the seeds having already escaped.

2. O. *Sturmii*, caule elongato, foliis lanceolatis recurvato-patentibus siccitate erectiusculis, capsula immersa versus apicem solummodo sulcata, calyptra villosissima.

O. Sturmii. Hornsch. Bot. Zeit. 1819, p. 89. Funck Deutschl. Moose. p. 35. t. 23.

Hab. Upon rocks in the Carinthian Alps; Hornschuch.

This may be distinguished from the preceding by its much larger size, far less rigid habit, narrower and recurved leaves, and, above all, by its capsule, which is either quite smooth, or, when ripe, sulcated only at the extremity, and by its excessively hairy calyptra. We know not that it has at present been found in any other station than the mountains of Carinthia. An excellent figure of it is that by Sturm in his Deutschland Flora.

* * *Capsula exserta.*

† *Capsula lævi. Calyptra glabra, basi quadridentata.*

3. O. *rugifolium*, caulibus repentibus, foliis ellipticis rugoso-striatis mucronulatis, capsula oblongo-ovata lævi, calyptra nuda lævi.

O. rugifolium. Hooker, Musc. Exot. t. 128.
HAB. Rio Janeiro; William Swainson, Esq.
This species is very remarkable from the wrinkled appearance of the upper half of the leaf. The teeth are long and narrow, and the columella reaches considerably beyond them. The calyptra exactly resembles that of *Schlotheimia squarrosa, Schwaegr. Suppl.* t. 56, but both the leaves and the peristome are of a very different nature.

†† *Capsula lævi. Calyptra glabra, basi multifida.*

4. O. *longipes*, caulibus repentibus, foliis ovato-lanceolatis striatis siccitate tortis, seta longissima, capsula ovali-elliptica lævi, calyptra striata inferne laciniata.

O. longipes, Hooker, Musc. Exot. t. 24.
HAB. Dusky Bay, New Zealand; A. Menzies, Esq.
Leaves of a fine orange brown; setæ numerous and very long. Capsules smooth, furrowed only at the mouth; operculum as long as the capsule. Peristome of 16 narrow teeth; columella exserted.

5. O. *Swainsoni*, caulibus repentibus foliis ellipticis longitudinaliter plicatis apiculatis siccitate tortis, capsula ovali lævi calyptra striata, inferne laciniata.

O. Swainsoni, Hooker, Musc. Exot. t. 127.
HAB. Rio Janeiro, William Swainson, Esq.
Leaves dark brown, the upper ones green; seta short; peristome of 16 white teeth; columella very much exserted.

6. O. *urceolatum*, caulibus repentibus, foliis lanceolato-attenuatis dorso carinatis, siccitate strictiusculis, capsula urceolata lævi, calyptra striata longe laciniata.

O. urceolatum, Hooker, Musc. Exot. t. 124.
HAB. St. Helena, A. Menzies, Esq.
Habit of *O. prorepens;* but differing essentially in the calyptra, in the form of its capsule, and in that of the leaves, which are moreover remarkably fragile.

7. O. *gracile*, caulibus erectibus? elongatis, foliis lanceolato-subulatis flexuosis siccitate tortis, capsula ovata, calyptra striata longe laciniata.

O. gracile, Hooker, Musc. Exot. t. 27.

Macromitrion gracile. Schwaegr. Suppl. v. 2. p. 39. t. 112.

HAB. Dusky Bay, New Zealand, A. Menzies, Esq.

The habit of this plant very much resembles that of *Trichostomum patens*. Seta short; and in consequence of the proliferous shoots, apparently lateral. Peristome unknown; nevertheless Schwaegrichen has arranged this species in his genus *Macromitrion*.

8. O. *aciculare*, caulibus repentibus, foliis lanceolato-acuminatis spiraliter tortis, capsula ovato-globosa, calyptra sulcata, basi fimbriata.

Schlotheimia acicularis, Brid. Sp. Musc. v. 2. p. 21.

Macromitrion aciculare, Brid. Meth. Musc. p. 132. Schwaegr. Suppl. t. iii. (bona.)

Orthotrichum pallidum, Beauv. Œthéog. p. 81.

Trichostomum arbustorum, Brid. Sp. Musc. v. 1. p. 241.

HAB. Isles of France and Bourbon. Aubert du Petit Thouars.

The leaves of this plant are of a singularly pale colour, and are curiously spirally twisted, crisped when dry. The peristome, according to Schwaegrichen, is simple, the teeth short, lanceolate, erect, and white. That author has not seen the epiphragma, but, from analogy, he places it in the genus *Macromitrion*.

9. O. *clavellatum*, caulibus repentibus, foliis ovato-lanceolatis concaviusculis acutis siccitate striatis imbricatis, capsula ovato-globosa subturbinata, calyptra inferne striata, basi multifida. TAB. IV.

Hypnum clavellatum, Linn. Sp. Pl. p. 1596. Turn. Ann. Bot. v. 2, p. 197.

Dill. Musc. p. 551. t. 85. (non t. 35, ut in Linn. Sp. Pl.) f. 17.

Gymnostomum prorepens, Hedw. Sp. Musc. p. 35. t. 3. (calypt. mala.) Schwaegr. Suppl. v. 1. p. 32.

HAB. Trunks of trees, in the middle states of North America.

This creeps to a great length, forming dense patches of an uniform green colour, and throwing up many stout and nearly simple branches. We are indebted to Mr. Turner, who compared specimens from Hedwig and Muhlenberg with those of Dillenius above quoted, for ascertaining that it is the *Hypnum clavellatum* of Linnæus. The plant certainly possesses the habit of an *Orthotrichum*, and we had long considered it to belong to that genus; but we believe that Mr. Arnott alone has discovered the peristome, and ascertained that it is composed of sixteen short, obtuse teeth. These teeth are so extremely fragile, that among the numerous specimens which we possess destitute of operculum, not one retains a vestige of them; but we have seen a white horizontal membrane covering the mouth of the capsule, as in *Gymnostomum microstomum*.

10. O. *microstomum*, caulibus repentibus, foliis lanceolatis

apiculatis siccitate tortis, capsula ovali lævi ore contracto sulcato, calyptra sulcata, basi laciniata. TAB. IV.

HAB. Van Dieman's Land; Dr. Spence.

Stems long and straggling, throwing up very many short branches. Leaves pale brownish green, spirally twisted when dry. Capsule deep-brown, the mouth singularly contracted, as in *O. Ludwigii*. Peristome single, the teeth narrow, white.

11. O.? *crispatum*, caulibus erectis? foliis lanceolatis acuminatis carinatis siccitate tortis, nervo crasso, capsula oblonga lævi, "calyptra basi lacera," glabra, "mediocri-sulcata."

Encalypta crispata, Hedw. Sp. Musc. p. 81. t. 10. Schwaegr. Suppl. 1. p. 60. (icon. calyptræ in t. 17, punctarum circulo inclusa.)

Ulota crispata, Swartz, MSS,

HAB. Cape of Good Hope; Thunberg.

We possess only imperfect specimens of this plant, which we received from the late Dr. Swartz; and in them the leaves are narrower towards the extremity than they appear in Hedwig's figure. The capsule is of a pale straw colour; the operculum has a long beak, and is red at the base. The calyptra, according to Schwaegrichen, is similar to most in this family; but, if Hedwig's figure be correct, the peristome is that of a *Weissia* or *Encalypta*, composed of sixteen long, narrow, equidistant, bright red teeth, meeting together over the mouth, and destitute of any central line.

Mohr, in his ingenious dissertation on the two genera, *Orthotrichum* and *Neckera*, which was published in the 2d vol. of the Annals of Botany, p. 542, thus remarks of this plant: "I am confident that this species has only one peristome, and that consisting of sixteen, non-geminate teeth, though its habit and curled leaves are quite the same as in the other Ulotæ."

12. O. *apiculatum*, caulibus repentibus, foliis oblongis mucronatis canaliculato-striatis siccitate tortis, capsula ovato-cylindracea, calyptra multifida.

O. apiculatum. Hooker, Musc. Exot. t. 45. Kunth. l. c. v. 1. p. 53.

HAB. Near Xalapa in the kingdom of Mexico, in the temperate regions. Humbold and Bonpland.

This is extremely allied, in general aspect, as well as in its leaves and capsule, to Schlotheimia squarrosa of Schwaegrichen, but the calyptra is widely different; and being ignorant of the nature of its peristome, we have not ventured to place it in the same division. Colour reddish-brown; leaves so remarkably carinated in the centre as to form two apparently distinct striæ.

13. O. *fimbriatum*, "erectum ramosum, foliis lanceolatis rupti-nervibus, tortilibus, capsula oblonga læv ccitate sulcata, operculo rostrato mediocri."

O. fimbriatum. Beauv. Æthéog. p. 80. Schwaegr. Suppl. 2. p. 37. t. iii.

Hab. Isles of France and Tristan d'Acunha. Aubert du Petit-Thouars.

A species unknown to us, and in its peristome equally so to Schwaegrichen, though that author has placed it in the genus *Macromitrion*. Colour of the leaves palish green. Calyptra "basi arcuato-laciniata, laciniis introflexis."

14. O. *mucronifolium*, caulibus repentibus, foliis lingulatis obtusis mucronulatis striato-carinatis siccitate crispatulis, capsula ovato-turbinata lævi, calyptra campanulata, basi subocto-laciniata. Tab. IV.

Hab. Upon stones and trunks of trees, especially about Mount St. Andrew, on the Island of St. Vincent, West Indies. Rev. Lansdown Guilding. Received also from A. Menzies, Esq. who gathered it in the same island.

A very beautiful species, with the leaves of a darkish-brown colour, but pale green at the extremity of the branches. Calyptra of a deep chesnut-brown; capsule red-brown. Certainly allied to *O. stellulatum*, but differing in its ovato-turbinate and decidedly smooth capsule.

††† *Capsula lævi. Calyptra pilosa.*

15. O. *Moorcroftii*, caulibus repentibus, foliis lanceolato-ligulatis, siccitate crispis, capsula oblongo-cylindracea, ore incrassato-sulcata, calyptra pilosa brevi-laciniata (operculo sublongo-rostrato.) Tab. IV.

Hab. Simirague in Nepaul, Dr. Moorcroft; communicated by Dr. Wallich.

Colour a fine orange-brown. Capsule brown, thickened at the very extremity, where it is also bright red and furrowed. Operculum, as in most of those from warm countries, much beaked; yellow, red at the base. Peristome unquestionably simple. Teeth sixteen, in pairs, nearly erect, shortish, and red.

16. O. *prorepens*, caulibus repentibus, foliis ovato-lanceolatis obtusis mucronulatis dorso carinatis siccitate vix crispatulis, capsula exacte ovali lævi, calyptra pilosa.

O. prorepens, Hooker, Musc. Exot. t. 120.

Hab. Dusky Bay, New Zealand. A. Menzies, Esq.

17. O. *filiforme*, caulibus filiformibus decumbentibus, foliis ovato-acuminatis substriatis, nervo evanescente siccitate strictiusculis, capsula cylindracea lævi, operculo brevi-rostrato, calyptra inferne laciniata. Tab. IV.

Lasia orthotrichoides. Raddi, MSS.

Hab. Communicated from Brazil by Professor Raddi.

The habit very much that of *Anomodon viticulosum*, but considerably more slender. Peristome certainly simple, composed of eight short, pale, obtuse, double teeth, each half marked with a central line.

Peristomio ignoto, sed ob habitum hujus divisionis.

18. O. *Nepalense*, caulibus repentibus, foliis ovato-lanceolatis subflexuosis striato-carinatis siccitate crispatis, perichætialibus majoribus convolutis acuminatissimis, capsula cylindracea lævi, calyptra valde pilosa, basi laciniata. Tab. IV.

Hab. Dhoopabasah and Beahico in Nepaul, Dr. Wallich.

The perichetial leaves of this plant resemble those of *O. recurvifolium*, and differ remarkably from the cauline ones. The mouth of the capsule is of a bright reddish orange colour. *Tab.* 4. f. 1. cauline leaf, f. 2. perichetial leaf.

19. O. *incurvifolium*, caulibus repentibus, foliis lanceolatis acuminatis carinatis apice incurvis, siccitate crispatis, capsula ovata lævi, calyptra longe laciniata. Tab. IV.

Hab. Island of Ternate, and in King George's Sound. Received from Mr. Dickson.

20. O. *undulatum*, caulibus repentibus, foliis sublongolingulatis obtusis mucronulatis insigniter undulatis inferne laxe reticulatis, siccitate crispatis, capsula oblongo-cylindracea lævi, calyptra basi multifida. Tab. IV.

Hab. Island of Ternate; communicated by Mr. Dickson.

This is of a very pale yellowish brown colour, throwing up numerous short, tumid erect branches, thickly clothed with remarkably undulated and, when dry, crisped leaves.

21. O. *involutifolium*, caulibus repentibus, foliis oblongo-lanceolatis obtusiusculis substriato-carinatis apice insigniter involutis, capsula oblongo-ovata lævi, calyptra inferne laciniata. Tab. V.

Hab. King George's Sound; received from Mr. Dickson: from New Zealand and Paramatta, New South Wales, by Mr. Hobson.

Branches short, tumid. Leaves singularly involute at their extremities, of a dullish green colour. Fruitstalks scarcely a quarter of an inch in length; capsule deep reddish-brown.

(Calyptra ignota.)

22. O. *subtortum*, caulibus repentibus, foliis lanceolato-acuminatis carinatis oblique recurvis, siccitate subspiraliter tortis, capsula ovato-oblonga, ore sulcato. Tab. V.

Hab. Received from the East Indies by Arch. Menzies, Esq.

The only specimens we possess of this moss are of a bright reddish brown colour, nearly two inches long, and in their whole habit much resembling *O. longifolium*.

† † † † *Capsula sulcata. Calyptra glabra, basi quadridentata.*

23. O. *ferrugineum*, caulibus repentibus, foliis oblongo-lingulatis obtusis mucronulatis siccitate tortuosis, dorso carinatis striatis, capsula cylindracea striata, calyptra glabra lævi (segmentis statu juniora inflexis.) Tab. V.

O. ferrugineum, Burchell's MSS.

Hab. Not rare upon trunks and the branches of trees in thick woods near George's Plain, Anteniqua Land, Cape of Good Hope. W. J. Burchell, Esq.

Colour a rusty brown, fully justifying the specific appellation given by our friend Mr. Burchell. Peristome decidedly simple, consisting of sixteen elongated teeth, which soon become revolute. We may remark that the calyptræ of this and the preceding species have a striking affinity with that of *Encalypta ciliata*. *Tab.* 5. f. 1. cauline leaf; f. 2. perichetial leaf.

† † † † † *Capsula sulcata. Calyptra glabra, basi multifida.*

24. O. *longirostrum*, caulibus repentibus, foliis lanceolatis acuminatis striatis, siccitate tortis, capsula ovali-elliptica sulcata, calyptra longe laciniata.

O. longirostrum, Hooker, Musc. Exot. t. 25. Kunth, Syn. Pl. Æq. Orb. Nov. v. i. p. 53. Macromitrion longirostrum. Schwaegr. Suppl. ii. p. 38. t. 112.

Hab. Dusky Bay, New Zealand, A. Menzies, Esq. At the roots of *Quercus Granatensis*, upon the Quindiù, near Quebrada de Toche, at an elevation of 1050 toises above the level of the sea. Humb. and Bonpl.

Schwaegrichen has placed this moss in his genus *Macromitrion*, of which the essential character is "peristomium simplex, dentibus sexdecim geminatis; epiphragma conicum dentibus interpositum operculo adhærens." What is considered by that author to be the epiphragma, he has represented at f. 13, but to us it appears to be nothing more than the exserted columella, which is frequently carried away within the operculum.

25. O. *acutifolium*, caulibus repentibus, foliis lanceolatis acuminatissimis siccitate tortis, capsula ovali striata, calyptra inferne laciniata atque striata. Tab. V.

Hab. Van Dieman's Land; Dr. Spence, and Mr. R. Neill.

Branches very numerous, erect, about three quarters of an inch in length, their leaves very dark brown below, yellow-green at the extre-

mity, furnished with a strong reddish nerve, which is frequently excurrent. Capsule exactly oval, and, as well as the beaked operculum, reddish-brown. Peristome reddish.

26. O. *serpens*, caulibus repentibus, ramis brevibus turgidis, foliis late lanceolatis flexuosis incurvis striato-carinatis siccitate valde crispatis, capsula elliptica calyptra basi sulcata. TAB. V.

O. serpens, Burchell's MSS.

HAB. Trunks and branches of trees in woods at Sylvan Station, near George's Plain, Antenigua Land, Cape of Good Hope. W. J. Burchell, Esq.

Stems creeping to a considerable length, bearing short branches, which, when moist, are remarkably tumid. Leaves yellowish-brown; fruitstalks not half an inch long. Capsule minute; peristome of 16 short teeth, approximating in pairs.

27. O. *stellulatum*, caulibus repentibus, pinnato-ramosis, ramulis erectis brevissimis, apice stellulatis foliis lineari-ligulatis obtusis brevissime mucronatis, capsula oblonga sulcata, operculo conico-subulato.

Schlotheimia stellulata. Hornschuch in Horæ Phys. Berol. p. 61. t. 12.

HAB. Woods on the banks of the Orinoco. Herb. Willd.

We do not possess fertile specimens of this plant. The calyptra is described as campanulate, sulcate, glabrous, laciniated at the margin, ferruginous, and shining. The peristome is unknown to Dr. Hornschuch.

28. O. *punctatum*, caulibus decumbentibus? foliis laxis lineari-oblongis acutis punctatis pellucidis planis patulis nervo sub apice evanescente, siccitate insigniter involutis, capsula oblongo-pyriformi, calyptra (juniore apice subpilosa) inferne sulcata basi fimbriata. TAB. V.

HAB. Communicated from Brazil, together with O. filiforme, by Professor Raddi.

This singular species possesses leaves much resembling those of *Polytrichum undulatum*, like which they are also remarkably involute when dry.

†††††† *Capsula sulcata. Calyptra pilosa.*

29. O. *anomalum*, caulibus erectis, foliis ovato-lanceolatis erecto-patentibus siccitate strictis, dentibus 8 geminatis, calyptra pilosiuscula.

O. anomalum. Hedw. St. Cr. v. 2. t. 37. (magnified peristome incorrect, for which see Hedw. Fund. v. 2. t. 7. f. 35.) Turn. Musc. Hib. p. 94. Hooker and Tayl. Musc. Brit. p. 72. t. 21. Schwaegr. Suppl. 1. Pt.

1. p. 37. Sturm, Deutschl. Fl. v. 4. t. 13. Moug. and Nestl. Pl. Exsicc. Vog. No. 29.

O. saxatile, Bridel.

Hab. Upon rocks and walls, throughout Europe.

Stems scarcely an inch in height. Leaves, when dry, tawny brown. Teeth of the peristome arched when moist, inclined or erect (never recurved) when dry. Hedwig, if we may judge from his representation of the peristome, confounded this plant with *O. cupulatum;* but we see no reason for altering its name, as Bridel has done, to *O. saxatile.*

30. O. *Drummondii*, caulibus repentibus, foliis anguste lanceolatis siccitate crispatulis, capsula elongato-clavata profunde sulcata, calyptra pilosissima.

O. Drummondii, Hook. and Grev. Grev. Crypt. Fl. t. 115.

Hab. On the trunks of young trees, especially birches, Scotland. First determined by Mr. Drummond, and now found to be abundant in alpine glens throughout the west of Scotland.

A beautiful species, in habit much resembling small specimens of *O. crispum,* but differing, even at first sight, by having the branches in the circumference of the tufts decidedly creeping, and essentially distinct, by its single peristome. This peristome is large in proportion to the diameter of the capsule, of an almost pure white, composed of sixteen teeth distinct at the base, but united in pairs at the extremity, spreading horizontally, or slightly deflexed. These pairs of teeth, being inserted in the furrows, their bases project so far into the mouth of the capsule, as to give it a remarkably angular, or even stellated appearance.

Peristomio ignoto.

31. O. *tenue;* caulibus repentibus, ramis tenuibus, foliis ovato-acuminatis siccitate strictis, capsula oblonga sulcata, calyptra valde pilosa, basi fissa. Tab. V.

Hab. Trees at the Cape of Good Hope; A. Menzies, Esq.; and W. J. Burchell, Esq.

Peristome unknown. Calyptra very much resembling that of many European *Orthotricha,* completely covering the capsule.

Calyptra ignota.

32. O. *recurvifolium,* caulibus repentibus, foliis ovatis longe acuminatis carinatis, recurvatis siccitate spiraliter tortis, perichætialibus majoribus convolutis, capsula ovato-oblonga læviter sulcata. Tab. V.

Hab. Communicated from Java to Mr. Dickson.

The leaves of this plant are singularly and beautifully recurved, and when dry spirally twisted. We regret that we have not seen the peristome, operculum, or calyptra of this species. *Tab.* 5. f. 1. cauline leaf, f. 2. perichetial leaf.

33. O. *microphyllum*, caulibus repentibus, ramis filiformibus, foliis ovato-lanceolatis, basi carinatis bistriatis pellucidis siccitate striatis appressis, capsula pyriformi læviter sulcata. TAB. VI.

HAB. Rather rare upon trees in thick woods at Sylvan Station, near George's Plain, in Anteniqua Land, Cape of Good Hope. W. J. Burchell, Esq.

Habit of *O. tenue*; seta and capsule red. Peristome unknown; but from what may be discerned of its imperfect remains upon one capsule, it would not surprise us if it should prove to have a double peristome. Calyptra, as well as the operculum, unknown.

B. PERISTOMIO DUPLICI.

* *Capsula immersa.*

† *Ciliis octo.*

34. O. *affine*, caulibus erectis, foliis recurvo-patentibus flaccidis late lanceolatis, capsula profunde sulcata, peristomii dentibus 8 geminatis, ciliis filiformibus, calyptra subpilosa.

O. affine. Hooker and Tayl. Musc. Brit. p. 4. t. 21.

α. majus; elongatum, calyptra superne præcipue pilosa. Hooker and Taylor.

O. affine. Schrad. Spicil. p. 67. Smith, Fl. Brit. p. 1263. Turn. Musc. Hib. p. 96. Eng. Bot. t. 1323. Schwaegr. Suppl. 1. Pt. 1. t. 49. (under the name of O. striatum; descr. Pt. 2. p. 19.) Moug. et Nestl. Pl. Exsicc. Vog. No. 323. Sturm, Deutsch. Fl. ic. O. heterophyllum. Beauv. Œthéog. p. 80? (Schwaegr.)

β. pumilum, caulibus brevibus, calyptra glabra. Hooker and Taylor.

O. pumilum, Swartz, Musc. Suec. t. 4. f. 9. Smith, Fl. Brit. p. 1264. Turn. Musc. Hib. p. 98. Engl. Bot. t. 2168. Schwaegr. Suppl. 1. Pt. 1. p. 50. Moug. et Nestl. Pl. Exsicc. Vog. No. 322. Sturm, Deutschl. Fl. ic.

HAB. Trunks of trees and old pales, Europe.

We are by no means able to distinguish this species from *O. pumilum*, of which the only characters are the smaller size, and entirely glabrous calyptra; and with regard to *O. rupestre*, that plant, according to Schwaegrichen's figure, differs only in the broader ciliary processes of its peristome.

35. O. *rupestre*, "peristomii interni dentibus 8 lanceolatis, capsula immersa subsulcata, foliis lanceolatis."

O. rupestre, Schleich. Crypt. Helv. Exsicc. Cent. III. No. 24. Schwaegr. Suppl. 1. Pt. 1. p. 27. t. 53. Funck, Deutschl. Moose, t. 23. (specimen wanting.)

HAB. Switzerland, Carinthia, and France. Arctic America, Dr. Richardson.

The only specimens which we have seen of this moss were received from Dr. Richardson, and they are destitute of perfect capsules. They were named by Schwaegrichen. The lower leaves are almost black, the uppermost ones of a brighter green than in *O. affine*, and the calyptra is more pilose.

36. O. *rupincola*, caulibus erectis vel procumbentibus, foliis suberectis strictis rigidis lata lanceolatis, capsula superne sulcata, dentibus 16 patentibus, calyptra valde pilosa.

O. rupincola, Funck, Deutschl. Moose, p. 35. t. 23. Grev. Crypt. Fl. t. 105.

Hab. Rocks and stones, Germany; Funck.—Very abundant in similar situations in Scotland; where its characters were first discovered by our friend M. Y. Stark. Rarely seen upon trees.

Besides the singularly rigid habit of this plant, and its much larger and more luxuriant mode of growth, it may be discriminated from *O. affine* by its broader capsule, by the inner peristome being extremely deciduous, the outer one erect, never reflexed, and by its more pilose calyptra.

37. O. *elegans*, caulibus erectis, foliis lanceolatis subrecurvis acutis, capsula oblongo-cylindracea lævi, peristomii dentibus octo revolutis, ciliis filiformibus, calyptra pilosa. Tab. VI.

O. elegans, Schwaegr. ined. Richardson, in Franklin's Journ. App. p. 756.

Hab. On trees, between latitude 54° and 64°, North America, Dr. Richardson.

We know not whether this species has been found by any other naturalist than our excellent friend just mentioned, who gathered it upon the over-land North American expedition, with Captain Franklin, and in whose collection it was named by Dr. Schwaegrichen. The specimens scarcely exceed an inch in length, and very much resemble those of *O. affine*, but their colour is a pale, yet bright green; the capsule is decidedly smooth, and the calyptra more hairy.

38. O. *obtusifolium*, caulibus erectis, foliis oblongo-ovatis obtusis (integris vel erosis) concavis nervo ante apicem evanescente, capsula oblonga sulcata, calyptra glabriuscula.

O. obtusifolium, Schrad. Pl. Exsicc. No. 14. Swartz, Musc. Suec. p. 90. t. 4. Schwaegr. Suppl. 1. Pt. II. p. 14. t. 50. Moug. et Nestl. Pl. Exsicc. Vog. No. 816. Funck, Deutschl. Moose, p. 35. t. 23. Sturm, Deutschl. Fl. icon.

Hab. Trunks of willow and beech trees, in the northern and temperate parts of Europe; and in subarctic America; (Dr, Richardson.) Not found in Britain.

Remarkable for the obtuseness of the leaves. Calyptra scariose and furrowed. Capsule of a deep yellow, and deeply sulcate. The peristome is commonly red; the teeth 16, recurved; the cilia composed of two parallel rows of cellules.

39. O. *Rogeri*, "peristomio interno 8-dentato, theca immersa sulcata, foliis lingulatis obtusis integerrimis, caule erecto." *Schwaegr.*

O. Rogeri Brid. Musc. Suppl. 2. p. 9. Schwaegr. Suppl. 1. Pt. II. p. 16. t. 53.

HAB. On trunks of beech trees upon the Jura mountains. Roger.

Peristome pale, the cilia composed of a single row of cellules. The leaves differ, according to Schwaegrichen, from those of all other species, in their form, their softer and thinner substance. To us it appears hardly distinct from the preceding.

†† *Ciliis sedecim.*

40. O. *diaphanum*, caulibus erectis (brevissimis), foliis lanceolatis apice acuminatis diaphanis, calyptra subpilosa.

O. diaphanum. Schrad. Spicil. p. 69. Smith, Fl. Brit. p. 1265. Engl. Bot. t. 1324. Schwaegr. Suppl. 1. Pt. 1. p. 31. t. 55. Hooker and Tayl. p. 74. t. 21. Moug. et Nestl. Pl. Exsicc. Vog. No. 325. Sturm, Deutschl. cum icone.

O. aristatum, Smith, Fl. Brit. p. 1265. Turn. Musc. Hib. p. 100. t. 9. f. 2.

HAB. Trees, walls, roofs, and old pales, Europe. South America, Dr. Gillies.

41. O. *rivulare*, caulibus procumbentibus, foliis late lanceolatis obtusis, ciliis setaceis, calyptra glabra.

O. rivulare, Smith, Fl. Brit. p. 1266. Turn. Musc. Hib. p. 96. t. 8. Hooker and Tayl. Musc. Brit. p. 75. t. 21. Eng. Bot. t. 2188. Hobs. Musc. Brit. No. 46.

HAB. Rocks and in streams, in Great Britain and Ireland.

Two or three inches long, of a very dark lurid green; leaves very obtuse. Ciliæ extremely narrow, and arising from the sides of the teeth. It appears to be unknown to the Continental Muscologists, though found in various parts of our own country.

42. O. *striatum*, caulibus erectis, foliis lanceolatis patentibus, siccitate strictiusculis capsula ovata lævi, ciliis torulosis, calyptra subpilosa.

O. striatum, Hedw. St. Cr. v. 2. t. 3. f. 9? Smith, Fl. Brit. p. 1263. Eng. Bot. t. 2187. Schwaegr. Suppl. 1. Pt. 1. p. 29. t. 54. Hooker and Tayl. Musc. Brit. p. 75. t. 21. Moug. et Nestl. Pl. Exsicc. Vog. No. 324.

HAB. Trunks of trees, throughout Europe.

Stems one to three inches in length. The inner peristome is of a very peculiar structure, broad, very pale coloured, and composed of moniliform joints, usually arranged in single rows, but not unfrequently having other joints attached to their sides. Moreover, the ciliæ do not arise from the sides of the exterior teeth, as in most other European species, but originate below their sinus, and form a different and an interior membrane, as in *Hypnum*.

43. O. *Lyellii*, caulibus erectis (elongatis) foliis lineari-lanceolatis subundulatis carinatis acuminatissimis, siccitate crispatulis, capsula oblonga sulcata, ciliis filiformibus, calyptra valde pilosa,

O. Lyellii, Hooker and Tayl. Musc. Brit. p. 76. t. 22. Moug. et Nestl. Crypt. Exsicc. Vog. No. 619. Hobs. Musc. Brit. v. 2. No. 47.

β. *Foliis longioribus siccitate magis crispatis.*

Hab. Trees in England, Scotland, Germany, and France. β. Nootka Sound, N. W. coast of America. A. Menzies, Esq.

Plant two to four inches or more in length, growing in lax, much branched tufts; and well distinguished from *O. striatum* by the much longer and narrower leaves; elongated and furrowed capsule: its ciliæ of a fine red colour, with the joints equal, and by no means moniliform.

* * *Capsula exserta.*

† *Ciliis octo.*

44. O. *speciosum*, caulibus erectis, foliis ovato-lanceolatis acuminatis patentibus, marginibusque ad apicem fere recurvatis, capsula leviter sulcata, peristomium dentibus octo demum sedecim reflexis, calyptra pilosa.

O. speciosum, Nees ab Esenbeck, in Sturm, Deutsch. Fl.? Moug. et Nestl. Pl. Exsicc. Vog. No. 722. Funck, Deutschl. Moose, p. 34. t. 23.
O. striatum, Hedw. St. Cr. v. 2. t. 36. f. 1—3.

Hab. On trees and rocks, Germany. Found on the island of Igloolik in the Polar Seas, by the expedition under Captain Parry, 1821-3. Discovered in Scotland by Mr. Reid and Mr. Drummond.

The present plant agrees perfectly with the description of Funck above quoted, and equally with his specimen, except that in the latter the capsule can scarcely be called exserted, whereas in this individual it is decidedly so. The figure of Nees, in Sturm's Flora, has likewise its capsule subimmersed and perfectly smooth; in which respect it agrees with O. *elegans*. In this individual the teeth are eight in number, geminate, soon becoming reflexed, and splitting into sixteen, which are approximated in pairs. Both in the specimens which we have received from Dr. Richardson, and those gathered at Igloolik by Mr. Edwards, the capsules are nearly as much exserted as in *O. anomalum;* a character which, with the different conformation of the teeth, serves to discriminate this from *O. affine*. The colour of the foliage is reddish-brown, resembling that of most tropical species.

The figures above quoted of Hedwig, excluding number 9, are so admirably characteristic of this species, that we have no hesitation in referring them to it.

45. O. *Hutchinsiæ;* **caulibus erectis, foliis lanceolatis erectis rigidis, capsula elevata sulcata, calyptra valde pilosa.**

α. nigrescente, foliis rigidioribus.

O. Hutchinsiæ. Engl. Bot. t. 2523. Hooker and Tayl. Musc. Brit. p. 73. t. 21. Hobs. Musc. Brit. v. 2. No. 44. Funck, Deutschl. Moose, t. 28. Moug. et Nestl. Crypt. Exsicc. Vog. No. 618.

β viride, foliis flaccidioribus.

O. aureum, Martius Fl. Crypt. Erlang. p. 77. t. 2.?

Hab. α. Rocks in the north and temperate parts of Europe. New York, Dr. Torrey. Near Boston, Messrs. Boott and Greene. Subarctic America, Dr. Richardson. β. on trees, Scotland, and in subarctic America, Dr. Richardson.

First discovered in Ireland by the late excellent cryptogamic botanist, Miss Hutchins.

46. O. *coarctatum,* caulibus erectis (4-6-linearibus) foliis lineari-lanceolatis, pellucidis punctatis undulatis siccitate crispatulis, capsula clavata sulcata, "calyptra hirta."

O. coarctatum Beauv. Æthéog. p. 80. Schwaegr. Suppl. 1. Pt. I. p. 26. t. 52.

Hab. In North America, according to Schwaegrichen. Communicated to us by Mr. Dickson.

This species has a considerable resemblance to *O. crispum,* but the leaves are more rigid and erect, and when dry, much less crisped. The whole moss is of a pale brownish yellow colour. Teeth 8, geminate, becoming reflexed, and sometimes split nearly to the base.

47. O. *Ludwigii,* caulibus repentibus, foliis erecto-patentibus anguste lanceolatis siccitate crispatulis, capsula pyriformi lævi ad apicem solummodo plicata, ore contractissimo, calyptra valde pilosa.

O. Ludwigii. Brid. Musc. Suppl. p. 26. Schwaegr. Suppl. 1. Pt. 2. p. 24. t. 51. Moug. et Nestl. Pl. Exsicc. Vog. No. 617. Sturm, Deutchl. Fl. icon.

O. clausum, Hornsch. MSS.?

Splachnum Wulfenianum, Schwaegr. Suppl. 1. Pt. 1. p. 46. t. 14.

Hab. On the trunks of chiefly young trees; Germany, Switzerland, and Scotland.

The foliage and ramification of this species very much resembles those of *O. Drummondii,* and the two mosses are frequently, at least in this country, found mingled into one tuft. The capsule of *O. Ludwigii,* differs however essentially, not only from that of its congener, but from that of every other species of *Orthotrichum* with which we are acquainted. It is exactly pyriform, of a very pale hue, smooth, furrowed only at the very extremity, and at the mouth so remarkably contracted, as, when dry, to leave no perforation at all, the base of the teeth literally meeting together. This species, we have every reason to believe, has been passed over for *O. crispum*, in consequence of the similarity of its place of growth and its crisped leaves. The capsule, however, is totally dissimilar, and the leaves are not more crisped than those of *O. Drummondii.*

It was not before we had examined very numerous specimens of this plant, both natives of the Continent and of our own country, that we were enabled to ascertain the presence of an inner peristome. It is composed of eight, exceedingly slender, ciliæ, arising from the sides of the teeth, and from their highly delicate nature, they are extremely fugacious. They are formed of a single row of elongated cellules. We may here observe, that Drs. Mougeot and Nestler, who published in their Stirpes a plant which they consider *O. Ludwigii*, afterwards, on ascertaining that it had no internal peristome, referred it to *O. clausum* of Hornschuch's MSS. We have quoted the latter plant, with a mark of doubt, though we cannot help believing, from our own experience, that the plant of Mougeot and Hornschuch is the same as ours, agreeing with it in every respect save in the alleged absence of an inner peristome.

We have quoted, also dubiously, the figure of Sturm, as it by no means agrees with any of our specimens, whether foreign or British; the magnified capsule being of a different form and deeply furrowed. It is also our opinion that the *Splachnum Wulfenianum* figured in Schwaegrichen's Supplement, is nothing but an injured specimen of this *orthotrichum*, as it very much accords with it in the leaves, capsule, and peristome.

48. O. *crispum*, caulibus erectis, foliis lanceolato-subulatis siccitate valde crispatis, capsula oblongo-clavata sulcata, peristomii dentibus patentibus reflexis, 8 geminatis, calyptra valde pilosa.

O. crispum, Hedw. St. Cr. v. 2. t. 35. Sp. Musc. t. 162. Schwaegr. Suppl. 1. Pt. 2. p. 23. Smith, Fl. Brit. p. 1266. Engl. Bot. t. 996. Hooker and Tayl. Musc. Brit. p. 73. t. 21. Moug. et Nestl. Pl. Exsicc. Vog. No. 30. Sturm Deutschl. cum icone.

Ulota crispa, Mohr.

O. curvifolium, Wahl. Supp. p. 365? (Schwaegr.)

Hab. Abundant on the trunks of trees in all parts of Europe; rarely upon walls. In North America, chiefly in subalpine situations.

Stems forming dense, prominent tufts, conspicuous from their rich yellowish, or reddish-green colour. The sterile plants have sometimes a creeping habit; leaves exceedingly crisped, fruitstalks long, and very numerous. As far as we can judge from the imperfect specimens which we possess of *O. curvifolium*, it appears in no respect to differ from *O. crispum.*

49. O. *plicatum*, caulibus repentibus, ramis brevibus, foliis ellipticis obtusissimis siccitate crispatulis recurvis, nervo vix ad apicem attingente, capsula clavato-pyriformi sulcata, calyptra integra lævi sursum pilosa.

O. plicatum, Beauv. Æthéog. p. 81. Schwaegr. Suppl. 1. Pt. 2. 18. t. 52.

Hab. In the Isle of France, Aubert du Petit-Thouars. Isle of Bourbon, Schwaegr. MSS.

Stems and branches very slender; outer peristome of eight geminate reflexed teeth; the ciliæ we have not ourselves seen. This is a remarkable species, having the leaves much resembling *O. obtusifolium*, and forming an exception to the general rule of structure in the species from warm countries, its peristome altogether resembling that of the European individuals.

† † *Ciliis sedecim.*

50. O. *pulchellum*, caulibus repentibus (brevibus), foliis anguste lanceolatis siccitate crispatis, peristomii dentibus sedecim per paria approximatis patentibus (coloratis), calyptra glabriuscula, basi plicata.

O. pulchellum, Engl. Bot. t. 1787. Hooker and Tayl. Musc. Brit. p. 75. t. 21.

Stems from half an inch to an inch long; leaves of a bright green colour; outer peristome of a fine red colour, spreading. Calyptra beautifully plicate at the base, the plicæ coloured at their extremity.

51. O. *perichætiale*, caulibus repentibus, foliis lanceolatis acutis flexuosis siccitate crispatulis, perichætialibus longissime setaceo-acuminatis, capsula ovato-turbinata ore incrassato, calyptra 4-5-fida pilosa. Tab. VI.

Hab. In the island of St. Vincent, A. Menzies, Esq. and the Rev. L. Guilding, who finds it upon Mount St. Andrew, bearing fruit in September.

Colour of the whole plant a fine orange-brown, glossy. The perichætium, probably on account of the innovations of the stem, appears placed below the extremity of the branches. Calyptra very deep brown; capsule reddish brown. The true nature of the peristome of this moss is difficult to be ascertained, because of its extreme fragility. The exterior consists of sixteen linear-lanceolate, obtuse, shortish red teeth, erect, or subpatent only at the extremity, all apparently united at their bases, at length recurved and distinct. The interior peristome is composed of sixteen, rather broad, yellowish ciliæ, springing from the internal membrane, and cleft nearly to the base; these alternate with the teeth. Sporules large, spherical smooth. The peristome easily separates from the mouth of the capsule in an entire state. *Tab.* 6. f. cauline leaf, f. 2. perichetial leaf.

52. O. *tortum*, caulibus repentibus, foliis lingulatis substriatis mucronatis siccitate spiraliter tortis, perichætialibus longissime setaceo-acuminatis convolutis, capsula oblonga sulcata.

Schizodon tortum, Swartz, MSS.
Hypnum torquatum, Hedw. Sp. Musc. p. 246. t. 63.
Schlotheimia torta, Schwaegr. Suppl. 1. Pt. 2. p. 39.
Neckera torta, Swartz, Fl. Ind. Occ. v. 3. p. 1806.

HAB. Trunks of trees in Jamaica, very rare. Swartz.

A species certainly very nearly allied to *O. perichætiale*, being of the same rich orange brown hue; the leaves appearing under the reflected light of a microscope, of a fine yellow, and having perichætical leaves of the same nature. We have never seen the calyptra or peristome: nor does any author seem to be acquainted with the moss in a perfect state.

††† *Peristomio interno membrana laciniata.*
(Omnibus calyptra lævi.)

53. O. *longifolium*, caulibus repentibus, foliis lanceolato-subulatis flexuosis integerrimis siccitate crispis, capsula brevi ovata sulcata.

O. longifolium, Hooker, Musc. Exot. t. 44. Kunth, Syn. Pl. Æquin. Orb. Nov. p. 63.

HAB. About the roots of *Bifaria glauca*, in the temperate region, at an elevation of 950 toises above the level of the sea, upon the declivities of the mountain Avila, near the Caraccas. Humboldt and Bonpland.

Habit of *O. cirrhosum*, having the leaves almost equally long and narrow, but quite entire; the capsula too is sulcated. This moss bears also some affinity to *O. aciculare*; in the latter, however, the leaves are of a singularly pale colour, and they are shorter and broader; and the capsule, like that of *O. cirrhosum*, is quite smooth. The peristome of this species is double, according to the observations of Mr. Arnott, the inner one consisting of an erect, lacerated, whitish membrane.

54. O. *squarrosum*, repens, ramis compositis fastigiatis, foliis lingulatis brevissime cuspidatis, theca cylindrica, operculo convexo-rostrato." *Schwaegrichen.*

Schlotheimia squarrosa, Brid. Suppl. Musc. 2. p. 18. Excl. Syn. O. pallidi γ. Schwaegr. Suppl. I. Pl. 2. p. 39. t. 56.

HAB. Isle of Bourbon, whence it was received by Persoon.

Leaves, when dry, spirally twisted, the nerve strong. Outer peristome composed of long, narrow, dark-reddish teeth, which, in a dry state, are very revolute. Inner peristome a conical, plicated, and according to Schwaegrichen, entire membrane, which at length becomes split into a number of irregular linear segments. Calyptra smooth, glabrous, fuscous, furnished at the base with four broad appendages.

55. O. *quadrifidum*, " erecta, subramosa, foliis oblongis cuspidatis, theca ovata, operculo convexo-rostrato sublongo." *Schwaegrichen.*

Sclotheimia quadrifida, Schwaegr. Suppl. 1. Pt. 2. p. 41. t. 57.
Orthotrichum angulosum, Beauv. Æthéog. p. 80. (fide Schwaegr.)

HAB. In the Isles of France, Bourbon and Tristan d'Acunha. Aubert du Petit Thouars.

Nearly allied to the last species, but wanting the creeping habit; the leaves also are lanceolate, and scarcely at all crisped when dry: the capsule is more ovate, and the beak of the operculum considerably longer. In the peristome and calyptra there appear to be scarcely any differences. Of this, as well as the preceding individual, our characters and descriptions rest wholly upon the authority of Schwaegrichen.

56. O. *Jamesoni*, " caule repente ramis erectis ramosis, foliis ellipticis longitudinaliter plicatis, nervo breviter excurrente, seta longiuscula, theca ovato-oblonga lævi, calyptra campanulata lævi, basi integra appendicibusque latis aucta." *Arnott*. TAB. VI.

O. Jamesoni, Arnott, in Act. Soc. Wern. v. 5. p. 201.

HAB. Woods near Rio Janeiro, communicated by Mr. W. Jameson.

Those species, of which the calyptra is provided with broad obtuse appendages at the base, generally bear a strong resemblance to each other. The moss now under consideration has not only a close affinity with *O. rugifolium*, but also with our *O. squarrosum*; from the former it differs in the foliage not being rugose, and in having the outer teeth of the peristome revolute instead of erect. From the latter species, to which it seems by Mr. Arnott's description to be still nearer akin, it is principally distinguished by the more elliptical leaves and broader capsule.

57. O. *Hornschuchii*, caulibus repentibus, foliis sublato-lanceolatis vix carinatis acutiusculis, capsula oblongo-clavata sulcata, calyptra glabra profunde laciniata. TAB. VI.

Schlotheimia pulchella. Hornsch. in Horæ Phys. Berol. p. 61. t. 12.

HAB. Upon the stems of Proteæ, on Table mountain, Cape of Good Hope.

We have been fortunate enough to discover the perfect peristome of this species upon plants of it received from Dr. Hornschuch. The teeth are sixteen in number, obtuse, erect, afterwards reflexed, pale yellowish: the inner peristome is a white membrane, jagged at the margin, and marked with numerous lines, which, however, never appear to split into ciliæ.

58. O. *sulcatum*, caulibus repentibus, foliis lineari-lanceolatis acuminatis undulatis siccitate crispis, capsula ovata profunde sulcata, calyptra multifida.

Schlotheimia sulcata. Hooker, Musc. Exot. t. 156.

HAB. Nepaul. Honourable D. Gardner.

Very nearly allied in habit to our *O. longifolium*, but extremely dissimilar in its peristome, of which the outer portion consists of sixteen linear, geminate teeth, at first erect and afterwards revolute, and the inner one is composed of a yellow, erect, reticulated membrane, irregularly cleft at the margin.

59. O. *cirrhosum*, caulibus repentibus, ramis elongatis flexuosis, foliis lineari-lanceolatis, attenuatis flexuosis serratis siccitate crispis, capsula turbinata lævi, calyptra profunde laciniata. TAB. VI.

Schlotheimia cirrhata, Schwaegr. Suppl. 1. Pt. 2. p. 45. Brid. Meth. Musc. p. 114.

Hypnum cirrhosum, Swartz, Prod. p. 42.

Anictangium cirrhosum, Hedw. Sp. Musc. p. 42. t. 5. f. 1—3.

Neckera cirrhosa. Swartz, Fl. Ind. Occ. v. 3. p. 1802.

Ulota cirrhosa.

HAB. Frequent upon trees in the West India islands. In the island of St. Vincent; where our friend, the Rev. Lansdown Guilding, finds it abundantly pendant from the trunks of trees in the declivities of Mount St. Andrew, bearing fructification in the month of September.

The noble specimens of this moss which we have received from Mr. Guilding have afforded us the opportunity which no other botanist possessed, of ascertaining the true nature of its beautiful structure. The peristome is unquestionably double, the teeth sixteen in number, marked with a central line, red, broadly linear; obtuse, at first erect, afterwards recurved, and even reflexed. Internal peristome, a yellow reticulated membrane shorter than the teeth, cleft at the margin, and disposed apparently to form sixteen broad laciniæ. The leaves are serrated, which is an anomaly in this genus: but it is much more evident upon some specimens than others, and their colour is a fine orange brown. The calyptra, which is at first linear-oblong, with the laciniæ closely approximated, afterwards becomes broadly campanulate and the laciniæ are very much spreading.

GLYPHOMITRION, (*Brid.*)

Griffithia, *Brown in Linn. Trans.* v. 13.

GEN. CHAR. *Seta* terminalis. *Capsula* apophysa nulla. *Peristomium* simplex, e dentibus 16 per paria approximatis, siccitate reflexis. *Calyptra* totam capsulam obtegens, integra, sulcata, basi sublaciniata quandoque hinc longitudinaliter fissa.

Mr. Brown has justly observed, that the following curious moss is allied to the genus *Orthotrichum*, especially in the approximation of its teeth to one another in pairs. We know of no species of that genus, however, in which the teeth are of so firm and rigid a texture, of so bright a red colour, or so strongly transversely striated. Upon the calyptra we consider the essential character to rest; this, even when the capsule has arrived at its full size, continues to envelope the whole, embracing with its base the summit of the seta. It is quite destitute of hairs, obscurely furrowed, very thin and membranous, irregularly cleft at the base, and often splitting open laterally like that of the genus *Calymperes*, to which we cannot help thinking this plant to be very nearly allied.

If Schwaegrichen had not followed Bridel in adopting the generic appellation of *Glyphomitrion*, we should assuredly have preferred the more recent one of *Griffithia*, employed by Mr. Brown; the more so, as Bridel framed his character chiefly with a view to include the *Encalypta crispata* of Hedwig, (our *Orthotrichum crispatum*,) and *E. parasitica*, (a moss which we have reason to consider a *Calymperes*,) both of which individuals are stated to have sixteen entire, equidistant teeth, and the former of which at least has a calyptra exactly similar to the other tropical *Orthotricha*. That author was entirely ignorant of the nature of the teeth in the present plant. Schwaegrichen has, with propriety, excluded the Hedwigian *Encalyptæ* from the genus *Glyphomitrion*, and we adopt the latter as constituted by him, together with his important character of the approximation of the teeth in pairs; but, instead of attending to the male flowers, we obtain a farther mark of distinction from the Calyptra.

1. Glyphomitrion *Daviesii*. Tab. VI.

G. Daviesii, Brid. Meth. Musc. p. 31. Schwaegr. Suppl. 3. p. 41. t. 113.

Grimmia Daviesii. Turn. Musc. Hib. p. 24. Hooker and Tayl. Musc. Brit. p. 39. t. 13.

Encalypta Daviesii, Engl. Bot. t. 1281.

Griffithia Daviesii, Br. in Linn. Trans. v. 13. p.

Hab. Upon rocks, generally by the sea-shore, on the western coast of England and Wales. Common in similar situations in Ireland, especially on the basaltic columns of the Giant's Causeway.

Stems rarely exceeding half an inch in height, tufted, bearing a considerable resemblance in habit, as Mr. Brown has observed, to *Gymnostomum Lapponicum*, and we may add, an equally strong one to *Trichostomum polyphyllum*. Leaves lanceolato-acuminate, carinate, entire, of a dark-brownish green colour, much crisped when dry; those of the perichætium broad and convolute. Capsule turbinate, beautifully smooth, and regular in its form, brown. Lid shortly conical, with a rather long and sharp beak.

This moss appears to be confined to the British islands. Tab. 6. f. 1. cauline leaf, f. 2. perichetial leaf.

ZYGODON, (*Hooker and Taylor.*)

GEN. CHAR. *Seta* terminalis. *Peristomium* duplex; *ext.* dentibus sexdecim per paria approximatis; *int.* e ciliis octo horizontalibus. *Calyptra* dimidiata.

Z. *conoideum*, foliis acutis.

α. minor, caulibus brevibus, foliis minoribus flavo-viridibus oblongis acutis pellucidis punctatis, nervo ante apicem evanescente.

Z. conoideum, Hooker and Tayl. Musc. Brit. p. 74. t. 21.

Bryum conoideum, Dicks. Pl. Crypt. Fasc. 4. t. 11. f. 2. Turn. Musc. Hib. p. 112.

Mnium conoideum, Engl. Bot. t. 1239.

Gymnocephalus conoides, Schwaegr. Suppl. 1. Pt. 2. p. 87.

β. elongata, caulibus elongatis, foliis flavo-viridibus lineari-oblongis pellucidis punctatis, nervo ante apicem evanescente.

γ. succulenta, caulibus brevibus, foliis nigro-viridibus majoribus obovato-oblongis opacis impunctatis inferne reticulatis, nervo valido excurrente.

Z. conoideum, Moug. et Nestl. Pl. Exsicc. Vog. No. 721.

Amphidium pulvinatum, Nees, in Sturm, Deutschl. Fl. cum icone.

Gagea compacta, Raddi.

HAB. α. Trunks of trees, Inverary, Dickson. Cranmore, near Belfast, Ireland, Mr. Templeton. Near Manchester, Hobson. Appin, Carmichael. Upon decaying trunks of *Ulmus campestris*, Strasbourg, Mougeot and Nestler. We also possess specimens from the south of France and Italy. β. New Zealand; first discovered there by A. Menzies, Esq. Van Dieman's Land, Dr. Spence and Mr. R. Neill. γ. Isle of France. Upon trunks of trees near Strasbourg, Mougeot and Nestler.

Previously to the accurate examination and comparison to which we subjected the various specimens of this moss which had been transmitted to us from different countries, we had been inclined to consider as specifically distinct what we have now enumerated above as mere varieties of *Z. conoideum*. It is certainly remarkable that the α and γ, both of which are found in Germany, are much more different from each other than the β. which is extra-european is from the α. The principal distinction between these two states, is that β. has elongated stems and narrower leaves, the texture of their foliage being the same, whereas γ has the leaves remarkably succulent, of a dark lurid green, and they are distinctly reticulated (not dotted) at the base. The same form of capsule prevails in the three varieties, but its relative size is greatest in γ, and the setæ also are more robust. In some specimens of this latter state, the capsules are of a fine yellow colour.

Z. *obtusifolium*, foliis obtusissimis.

Z. obtusifolium, Hooker, Musc. Exot. t. 159.

HAB. Nepaul. Hon. D. Gardner.

The general habit of this species is very similar to that of *Z. conoideum*, both in the structure of the foliage and shape of the capsule: but the leaves are remarkably obtuse, and the capsule is elongato-pyriform, while the whole plant is a vinous-red colour, approaching to brown.

ART. XXIV.—*Account of an Essential Oil, which flows spontaneously from a Tree in South America.* Communicated by Dr. Hooker.

It is with much pleasure that we are enabled to lay before our readers some account of a fluid, containing all the properties of an essential oil, which the natives of South America, in the district between the rivers Parime and Oronooko, are in the habit of extracting from a tree which, though it abounds in those regions, is unfortunately, as yet, unknown to naturalists. The information has been communicated to us by our excellent and scientific friend, C. S. Parker, Esq. of Glasgow, who, in a late visit that he made to Demerara, suffered no opportunity to escape him of investigating the botany of those fertile regions, whence he has already transmitted to his native country several valuable vegetable productions.

Mr. Parker's attention was particularly attracted by the *Native Oil of Laurel*, a fluid which seems to have been but recently heard of in the Dutch settlements, and which we are assured by Mr. Edmondstone of Cardross Park, near Dumbarton, (whose long residence in that country, as Protector of the Indians, gave him unusual facilities in obtaining scientific information,) was also unknown to those people a few years ago. Aided by the previous attention that Dr. Hancock, an experienced physician in the colony, had paid to the nature of this oil, Mr. Parker drew up an account of it, which was inserted in the Colonist (Demerara) newspaper, Jan. 18, 1824, and which, as comprising every thing that was known upon the subject up to that period, we shall here insert.

"*To the Editor of the Colonist,*

"SIR,—I take the liberty of communicating, for insertion in your Journal, a few observations on a very extraordinary vegetable production, the knowledge of which has, hitherto, been almost exclusively confined to the natives of Spanish Guiana. This substance, which has very injudiciously been termed *Azeytode Sassafras*, (an appellation which tends to confound it with the essential oil yielded by the *Laurus Sassafras* of the Northern Continent of America,) affords, so far as my knowledge extends, a solitary instance of a perfect volatile liquid, without the aid of art. Substituting for the appellation to which I have objected, the provisional name of '*Native Oil of Laurel*,' I shall describe the method of procuring it, and enumerate its principal chemical and medicinal properties, so far as these have been investigated and examined.

"The *Native Oil* is yielded by a tree of considerable height; its wood is aromatic, compact in its texture, and of a brownish colour, and its roots abound with essential oil.

"This tree, which is found in the vast forests that cover the flat and fertile regions between the Oronooko and the Parime, has, from an analogy already alluded to, been supposed to belong to the natural order *Laurineæ;* and though Humboldt and Bonpland do not seem to have been acquainted with its singular and important produce, its botanical characters may very possibly have been described in their *Nova Genera et Species Plantarum Americæ Septentrionalis*, under the genera *Ocotea*, *Persea*, or *Litsea*. This question I am, however, unable to solve, having never seen the parts of fructification.

"The *Native Oil of Laurel* is procured by striking with an axe the proper vessels in the internal layers of the bark; while a calabash is held to receive the fluid, which gushes out in such abundance, that several quarts may be caught from a single incision, if the operation be performed with dexterity. So obscure, however, are the indications of these reservoirs, that the Indians (with perhaps a little of their usual exaggeration,) assert that a person unacquainted with the art may hew down a hundred trees, without collecting a drop of the precious fluid. In many of its properties the native oil resembles the essential oil, obtained by expression, distillation, and other artificial processes: it is, however, more volatile and highly rectified than any of them, its specific gravity hardly exceeding that of alcohol. When pure, it is colourless and transparent; its taste is warm and pungent; its odour aromatic, and closely allied to that of the oily and resinous juice of the *Coniferæ*.[*] It is volatile, and evaporates without residuum at the ordinary atmospheric temperature.[†] It is inflammable, and except when mixed with alcohol, gives out in its combustion a dense smoke. Neither the alkalies nor acids seem to exert any sensible action upon the *Native Oil*; when combined, however, with sulphuric acid, the mixture assumes a momentary brownish tinge, but soon regains its transparency. The Oil of Laurel dissolves camphor, caoutchouc, wax, and resins; and readily combines with the volatile and fixed oils. It is insoluble in water, soluble in alcohol and in ether. Though the specific gravity of the oil greatly exceeds that of ether, the compound formed by combining them in the proportion of one part of the former to two of the latter, floats upon the surface of pure ether, and may therefore be the lightest of all known liquids.

"With respect to the medicinal properties of the *Native Oil*, it bears, when externally applied, the character of a powerful discutient, and appears, when exhibited internally, to be diaphoretic, diuretic, and resolvant; by many it is believed to be analeptic, alterative, and anodyne; and to promote the exfoliation of carious bones.

"Without listening to the extravagant reports of the Indians, who exalt it into a panacea, we must admit that its efficacy has been demonstrated in cases of rheumatism, swellings of the joints, cold tumours, and in the various disorders supposed to originate in a vitiated state of the blood, (*mala sanguis.*) In all these cases, it is exhibited in doses of from thirty to forty drops, twice a-day, accompanied by frequent and continued friction of the parts affected with the oil, while the body is kept moderately warm, and a free use of diet and drinks prescribed to the patient. The same practice is said to have been attended with the happiest effect in paralytic disorders; for this I cannot vouch, but have found it a valuable remedy in cases of nervous rheumatic headach, sprains, and bruises. A decoction of the root has been recommended as an alterative in various chronic complaints.

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[*] So striking is this resemblance, that a friend, to whose inspection I submitted the oil, pronounced it, rather hastily, to be spirit of turpentine.

[†] 75 deg.—85 deg. Fahrenheit.

"I am fully aware of the reaction that often results from over-excited and disappointed expectation, and of the discredit into which a new remedy frequently falls in consequence of the unmerited encomiums which those who bring it into notice have injudiciously bestowed upon its virtues.

'Quidquid excessit modum,
Pendet instabili loco.'

"However slight the credibility we may feel inclined to attach to the evidence of the Indians, upon which our knowledge of the medicinal properties of the native oil almost entirely reposes, the information derived from experience surely claims that attention, and justly challenges that examination, which we should not hesitate to bestow on the speculations of the mere theorist. Let inquiries be instituted, and experiments be made, by those whom their situation and scientific attainments qualify for the task. By these investigations it may not only be ascertained what degree of confidence ought to be reposed in the unqualified encomiums which the Indians lavish upon this anomalous production; but properties unknown to them may be discovered; and its history, which they have been accused, perhaps unjustly, of involving in obscurity, be satisfactorily elucidated. To the chemist, and the vegetable physiologist in particular, the *Native Oil of Laurel*, elaborated by the unassisted hand of nature, in a state of purity which the operose processes of art may equal, but cannot surpass, presents an interesting subject of inquiry, and a wide field of speculation."

Samples of this oil having been received by H. Rainy, Esq. they were, through his liberality, communicated to Dr. Thomson, Dr. Wollaston, and Mr. Macintosh. The latter gentleman has found it to answer the purpose of dissolving the caoutchouc preparatory to this substance being employed to render cloth, &c. water-proof, equally well with the Naphtha which he has been accustomed to use. It is therefore to be hoped, that, besides its medical properties, the Native Oil of Laurel may be found to possess qualities that may be serviceable in the arts, and thus become an important article in commerce.

We may here observe, that, in M. Kunth's Synopsis of the plants described in the *Nova Genera*, &c. of Humboldt, mention is made of a doubtful species of laurel, ***Laurus Jaritensis***, (which is not, however, enumerated in the large work,) a native of shady forests in the district of Oronooko, of which it is said, "Folia odorem terebinthinum spirant." May not this be the tree in question? The great South American travellers, Humboldt and Bonpland, did not, however, discover it either in flower or in fruit.

We are assured by Mr. Parker, that Dr. Hancock intends to use his utmost endeavours to procure perfect specimens of the plant which affords the *Native Oil of Laurel*, which he will transmit to this country.

ART. XXV.—*Observations on Double Stars.* By M. STRUVE of Dorpat.

IN the third volume of M. Struve's Observations, the additional remarks on the double stars relate only to three, viz. ξ Ursæ majoris, γ Virginis, and *p* Ophiuchi. In these the relative changes of place are very considerable.

1. ξ *Ursæ Majoris.*

The rate of change of the angle of position of these two stars appears greater now than in any other, (*Edinburgh Journal*, vol. ix. p. 336,) and is confirmed by the most recent observations.

Angle of Position.

1821, April 23. = 1° 2 South preceding.
1821, Dec. 12. = 7 6 South preceding.
1822, Jan. 29. = 7 1 South preceding.

Thus the smaller star, which in the years 1819 and 1820, was more northerly than the larger, has quickly passed into a southern situation. M. Struve's observations for four years give:

Years.	Dec.	Angle of Position.
1818,	10.	14° 33′ North preceding.
1820,	13.	6 21 North preceding.
1821,	31.	1 12 South preceding.
1822,	08.	7 21 South preceding.

2. γ *Virginis.*

In the second volume of Struve's Observations, it is shown, (see *Edinburgh Journal,* vol. ix. p. 357,) that the two stars which compose this double star had diminished their distance between the time of T. Mayer and the first observations of Dr. Herschel, and that the angle of position also had much decreased.

This star was occulted by the moon, on the 20th of April 1720. The observation was made at Paris. Both the immersion and the emersion were observed; and from hence may be deduced the relative positions of these two stars in 1720. The computations have been made by the late Professor Walbeck, to whose skill and experience M. Struve gives a just tribute of praise. He finds the distance = 7″49, and the angle of position = 49° 7, south following or north preceding.

This distance, M. Struve remarks, appears to confirm what he had previously stated of the diminution of distance.

The observed distances stand thus:

Distance in Year			
1720	=	7″49	by Cassini.
1756	=	6 5	by T. Mayer.
1780	=	5 7	by Herschel.
1819	=	3 56	by Struve.

The angles of position are,

1720	49° 7	N. preced.	Cassini.
1756	54 4		T. Mayer.
1782	40 9		Herschel.
1803	30 3		Herschel.
1820	15 2		Struve.

According to M. Struve, there is room for suspecting, that between 1720 and 1756 this angle attained its maximum; and that the stars receding from each other for some time after 1720, again approached, and have continued approaching to our time.

3. *p* 70 *Ophiuchi,* (70 Serpentarius, *Edinburgh Journal,* vol. ix. p. 338.)

Of this remarkable double star, before noticed, the late observations confirm the rapid change of the angle of position, and, consequently, the quick apparent revolution of one star about the other. The distance of these stars M. Struve finds, by accurate observations in 1821, to be = 4″26.

Art. XXVI.—*Account of a curious Electro-Magnetic Experiment.* By Professor Barlow. *Exhibited at the London Institution, by* Dr. Birkbeck, *in his Lectures on Electro-Magnetism.*

The following curious electro-magnetic experiment was exhibited by Dr. Birkbeck, on the suggestion of Professor Barlow, at the London Institution, on the 26th May. A hollow globe of wood, 15 inches in diameter, was first accurately turned, and from the equator towards each extremity of its axis grooves were cut parallel to the equator, at the distance of 4½° from each other, like parallels of latitude, and another, rather deeper, groove from one pole to the other, along a meridian half-round.

Beginning now at the equator with the middle of a wire, about 90 feet in length, and one-tenth of an inch in diameter, which just fitted the grooves, it was carried round in the successive circles towards each pole, making an abrupt turn from one circle to another along the meridian groove above mentioned. From the point where the wire arrived at the poles, it was carefully bound with silk, and returned back again to the equator, along the same meridian. The two ends of the wire being thus brought together, they proceeded to a little distance from the globe, where they terminated. By this means the effect of the short abrupt turnings of the wire along the meridian towards the poles, is counteracted by wire returning back again from the poles to the equator, leaving thereby only the parallel wires active when the two extremities are connected with the battery.

The globe being thus far formed, it is covered with zones, in the usual way, so as to exhibit to appearance a common 15-inch terrestrial globe, the wire being completely hidden. But this covering is so laid on, that, instead of the terrestrial pole coinciding with the poles formed by the wire, the latter is brought into Lat. 75° N. and Long. 76° 40′ W. which is the situation which Mr. Barlow conceives will best agree with the observed bearings of the needle in most parts of the world. Things being thus adjusted, the globe is placed on a large cup, not shown in the figure, near the battery, so as to admit of its being placed in any position, or so as to bring any part to the zenith, without the encumbrance of the usual brazen meridian and horizon. A needle is now suspended over the globe, as shown in Plate VIII. Fig. 2, where *a b c* is a light piece of brass bent as in the figure, between which is hung the small magnetic needle *n s*, which turns on its axis *a b*, in two fine holes at *a* and *b*, in the wire; leaving thus the needle free to take any dip; while, by means of the silk suspension *c d*, it is also free to take any direction; lastly, the needle is insulated from the action of terrestrial magnetism by opposing to it the north end of a small bar magnet NS in the line of the dip. By this means the needle retains its magnetic power, but is under no magnetic influence.

The extremities of the curves being now connected with the poles of the battery, the globe immediately becomes strongly active upon the needle, causing it to assume the same dip, and the same direction with respect to the artificial globe, as the actual needle does in the corresponding part of the earth itself, at least to a very considerable extent. Thus, if we bring the Island of Ascension to the zenith, the needle is found perfectly horizontal, with a slight westerly variation. If we bring London to the zenith, we find the dip about 70°, and 24° or 25° of westerly variation; if the globe is again shifted in position, so as to bring Cape Horn in the zenith, the dip is about 60° the contrary way, that is, with the south end below; and the variation about 30° easterly, and so on with various other places.

The purpose of this experiment is to show, that what we have hitherto considered as the magnetism of the earth, may be only modified electricity, and to illustrate, experimentally, the theory advanced by M. Ampere, who attributes all magnetic phenomena to electric currents.

LONDON, *May* 28, 1824.

ART. XXVII.—HISTORY OF MECHANICAL INVENTIONS AND PROCESSES IN THE USEFUL ARTS.

THERE never was a period of the history of Europe more entitled than the present to be called the age of invention. The cultivation of the arts of peace has now become general throughout Europe and America; and it is a singular and gratifying sight to observe the rapid importation of inventions into England, as the only country where they are likely to receive their commercial reward. This excellent effect arises from that wise provision in our patent law, which grants an exclusive privilege for fourteen years to the importer and introducer of a new invention; a provision which, while it gives this country the advantage of foreign genius, has a tendency also to repay the benefit by the high encouragement which it holds out to other nations.

In the following brief account of mechanical inventions, we cannot pretend to lay before our readers accurate details of complicated machinery or of tedious processes; but we shall gain our object if we can convey general views, and thus enable the mechanist to comprehend the spirit of the invention, while we point out to him by proper references the works in which more minute information may be obtained.

1. *Mr. Babbage's Calculating Machinery.*

The extraordinary machinery invented by Mr. Babbage, and now constructing under the patronage of Government, has excited so much interest in every part of Europe, that we have been anxious to gratify the curiosity of our readers by any details respecting the nature and progress of the machine. Although we have had the advantage of receiving from the inventor himself a verbal explanation of the general principles involved in the mechanism, and of some of the particular constructions which are characteristic of the invention; yet it would be impossible, without the aid of numerous figures, and even of models, to render the machinery intelligible even to a mechanical reader. It may be sufficient, however, to state, that the machine is extremely simple in its construction, and that all its functions are performed with a very slight mechanical power.

The machine now constructing by Mr. Babbage is intended to compute tables with four orders of differences, and there will be attached to it an apparatus for punching upon copper, or impressing upon some other soft substances the figures which it computes. The permanency of these impressions may be secured either by stereotyping, or by some other processes.

"This machine * computes, in all cases, to the nearest figure, whatever it may be; that is, after the required number of figures are computed, if the next following figure should be a 5 or upwards, the last figure is increased by unity, without any attention on the part of the operator.

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* These observations are taken from Mr. Baily's account of Mr. Babbage's machine, addressed to Professor Shumacher. See *Astron. Nachr.* No. 46.

But it is not in these mechanical contrivances alone that the beauty and utility of the machine consist. Mr. Babbage, who stands deservedly high in the mathematical world, considers these but of a secondary kind, and has met with many curious and interesting results, which may ultimately lead to the advancement of the science. The machine which he is constructing will tabulate the equation $\Delta^4 u_z = c$; consequently there must be a means of representing the given constant c, and also the four arbitrary ones introduced in the integration. There are five axes in the machine, in each of which one of them may be placed. It is evident that the arbitrary constant must be given *numerically*, although the members may be any whatever. The multiplication is not like that of all other machines, viz. a repeated addition, but is an actual multiplication; and the multiplier as well as the multiplicand may be decimal. A machine possessing five axes (similar to the one now constructing) would tabulate, according to the peculiar arrangement, any of the following equations:

$$\Delta^5 u_z = a u_{z+1} \qquad \Delta^5 u_z = a u_{z+2}$$

$$\Delta^5 u_{z+1} = a u_z + \Delta^4 u_z \qquad \Delta^5 u_{z+1} = a \Delta^5 u_{z+1} + \Delta^4 u_z$$

If the machine possessed only three axes, the following series, amongst others, might be tabulated:

$$\Delta^2 u_{z+1} = a \Delta u_z + \Delta^2 u_z \qquad \Delta^3 u_z = a u_z$$

If there were but two axes, we might tabulate

$$\Delta^2 u_z = a u_{z+1}$$

These equations appear to be restricted, and so they certainly are. But since they can be computed and printed by machinery of no very great complication, and since it is not necessary (after setting the machine at the beginning) to do any thing more than turn the handle of the instrument, it becomes a matter of some consequence to reduce the mode of calculating our tables to such forms as those above alluded to.

A table of logarithms may be computed by the equation $\Delta^4 u_z = c$; but in this case the intervals must not be greater than a few hundred terms. Now, it may be possible to find some equation similar to those above mentioned, which shall represent a much more extensive portion of such tables,—possibly many thousand terms: and the importance that would result from such an equation renders it worthy the attention of mathematicians in general.

A table of sines may, for a small portion of its course, be represented by the equation $\Delta^2 u_z = c$: but it may be represented, in its whole extent by the equation $\Delta^2 u_z = a u_{z+1}$. Now, this is precisely one of the equations above quoted: and if a proper machine were made (and it need not be a large one) it would tabulate the expression A sin. θ from one end of the quadrant to the other, at any interval (whether minutes or seconds) by only once setting it. It would not be very complicated to place three such machines by the side of each other, and cause them to transfer their results to a common axis, with which the printing apparatus might be connected. Such a machine would, amongst other tables, compute one from the expression

$$A \sin. \theta + B \sin. 2\theta + C \sin. 3\theta.$$

the utility of which, in astronomy, is well known. In fact Mr. Babbage is of opinion that it would not be impossible to form a machine which should tabulate almost any individual equation of differences.

Amongst the singular and curious powers produced by small additions to the machinery, may be reckoned the possibility of tabulating series expressed by the following equation:

$\Delta^2 u_z =$ the units figure of u^z

$\Delta^3 u_z = 2x^3$ the figures found in the tens place of u_{z+1}

$\Delta^5 u_z = 4x$ the figures found in the units and tens place of u_{z+1}

and many others similar thereto.

Again, let the machine be in the act of tabulating any series, a part may be attached by means of which, whenever any particular figure (a 6 for example) occurs in the units place, any other number (23 for instance) shall be added to that and all the succeeding terms; and when, in consequence of this, another figure 6 occurs in the units place, then 23 more will be added to that and all the succeeding terms. Or, if it be preferred, the number added shall be added to the term ending in 6 only, and not to all succeeding ones."

2. *Explosive Engine.*

An engine of a very remarkable kind is, we understand, about to be brought into public notice; which, if it answer the high expectation of its inventor, may ultimately supersede the use of the steam-engine. The patents for England and Scotland are, we believe, both completed, so that we may expect soon to hear the particular details of its construction.

At the lower end of a small cylinder is placed a minute apparatus for producing oil gas. As the gas is generated, it elevates a piston so as to admit as much atmospheric air as when combined with the oil gas would render the mixture explosive. When the piston has reached this height, the gas is exploded, and the mechanical force of the explosion is employed to drive machinery. Experiments have, we understand, been actually made with this power, which was employed to force up water to a considerable height.

Our readers will no doubt be reminded by this brief notice, of the ingenious invention of the Rev. Mr. Cecil, by which the power is obtained by taking advantage of the vacuum created by the explosion of a mixture of hydrogen and common air.* Mr. Cecil suggested in his paper that the expansive force of the explosion might also be employed; but his machine was not founded on this principle.

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* See *Cambridge Transactions*, vol. i. part 2.

3. *Clymer's Improved Ploughs.*

Our readers are no doubt aware, that two methods have already been published for forming the mouldboards of ploughs, the one by Mr. Amos, in the *Transactions of the Agricultural Society*, and the other by Mr. Jefferson, which has been published in the *Philosophical Magazine*, and in the *Edinburgh Encyclopædia*, article AGRICULTURE. Mr. Clymer, however, seems to have improved upon these methods, and to have produced a mouldboard which turns the furrow with less friction and resistance than any other plough, the force exerted in pressing laterally and in lifting the clod being equally divided.

Mr. Clymer forms two mouldboards, one to be used on light land, and the other on stiff or wet land; but the geometrical rules are too long to be given here; so that we must refer the reader to Newton's *Journal of the Arts*, No. XL. p. 170.

Another of Mr. Clymer's improvements consists in a new construction of the beam and its appendages, by means of which the draught of the plough may be adjusted to produce any required depth and width of furrow, and also to suit a single or a double team.

4. *Hydro-Pneumatic Lamp.*

The discovery of M. Dobereiner of the remarkable action of Spungy Platinum upon Hydrogen Gas, has led to the construction of an elegant lamp for producing instantaneous light.

This lamp was, we believe, first made for sale by Mr. Garden of London; but it has since been constructed in an improved form by Mr. Adie, Optician in this city.

The form given to the lamp by Mr. Garden is shown in Plate I. Fig. 3, where AB is a glass globe fitting tightly by a ground shoulder into the neck *m n*, of another globe or vessel CD. The globe AB terminates downwards in a hollow neck, *m n o p*, in the lower end of which is placed a small cylinder of zinc *o p*. Into the neck of the vessel CD is fitted a brass piece, *a b c*, through which the gas contained in CD can escape at the point *c*, by turning a cock *d*. An arm *e f* slides through *h*, and carries in a brass box P a piece of the spungy platinum, which can be brought nearer to *c*, or removed from it by sliding the arm *e f* through *h*.

If we now pour diluted sulphuric acid into the vessel AB by the mouth at S, it will descend through the neck *m n*, compressing the air in CD if the cock *d* is shut. The diluted acid will now act upon the ring of platinum, *o p*, and produce hydrogen gas, which after the common air in CD is let off, will gradually fill the vessel CD. When the gas is thus collected in the vessel CD, a stream of it may at any time be discharged through the aperture *c*, and thrown upon the spungy platinum P, when it will produce such an intense heat as to make the platinum red hot, and thus afford an instantaneous light.

In Mr. Garden's lamp, the ring of zinc *o p* floats upon a piece of cork, so that when the vessel CD is filled with gas, the dilute acid does not touch the zinc, and consequently no more hydrogen is produced; but the moment any of the gas is let off at *c*, the pressure of the head of fluid in AB overcomes the elasticity of the remaining gas in CD, and the diluted acid is forced up to the zinc, to reproduce the wasted hydrogen.

By this ingenious contrivance, the diluted acid is pressed up against the zinc when more hydrogen is wanted, and withdrawn from it when the vessel CD is full.

The form given to the lamp, by Mr. Adie of this city, is shown in Fig. 4, where the different parts are marked by the same letters as in Fig 3. In this construction, a cone of glass *k* formed on the bottom of the vessel AB is made to hold the ring of zinc, *o p*, which remains permanently in that position. This lamp has the advantage of greater stability, and is less liable than the other to be deranged by an accidental cause.

Professor Cumming of Cambridge, who constructed one of these lamps in December 1823, found it necessary to cover up the platina with a test tube, or a cap, after every experiment. With platina foil $\frac{1}{1387}$ of an inch in thickness, and kept in a close tube, he produced the same effect; but when the thickness of the foil was $\frac{1}{8440}$, it was necessary to raise it previously to a red heat.

These lamps, besides their extreme beauty as philosophical toys, are of great use in counting houses, as well as in private houses, in summer, when there is no fire at which a taper can be lighted.

5. *White's Floating Breakwater.*

Among the practical and useful inventions of the present day, the floating breakwater of Mr. White, for which he has received a patent, promises to hold a respectable place.

This contrivance consists of a series of square frames of timber, connected by mooring chains, or cables, attached to anchors or blocks; they are disposed so as to enclose either a rectilineal or a curvilineal space for the reception of ships, which may ride there, protected from the breaking of the sea or surf.

These frames consist of logs of Quebec yellow pine, from thirty to fifty feet long, and from eighteen to twenty inches thick. The logs are bolted together so as to form a square frame, consisting of two parallel frames. The separate frames are connected by ropes or chain cables, secured to anchors or mooring blocks. The height of these frames may be increased by logs or pieces of timber on the tops of the frames, not exceeding five tiers in a vertical position, for the purpose of breaking the waves more completely in places where the water is violently agitated.

The advantages of this breakwater have been actually experienced at Deal, and certified by some respectable persons of that place.

The inventor recommends it particularly for fishing coasts, where the surge often prevents boats from putting off and landing; and also for bathing places, where it will always produce smooth water, and protect the machines. A drawing and more minute description of this invention will be found in Newton's *London Journal of Arts, &c.* vol. vii. p. 232.

6. *Perkins's Steam Engine.*

We understand that Mr. Perkins has at last completed his apparatus, so as to demonstrate to a select party of friends the power of his engine, by lifting a given volume of water through a certain height. The particulars of the experiment, with which we are not yet acquainted, will, we have no doubt, be communicated to us before the appearance of our next number. *

The history of this great invention, which Mr. Perkins has published for the use of his friends, exhibits an interesting picture of the progress of discovery in a mind capable of availing itself of those facts and views which accident and speculation frequently present to it. The tremendous explosions which often take place in iron foundries when a drop of water has got into the mould, and other facts, convinced Mr. Perkins that water confined by pressure until it became sufficiently charged with heat, was capable of exerting a force almost incalculable. The interest excited in England by steam engines, turned his attention particularly to their construction. In his earliest speculations he was convinced that much heat was lost, in consequence of a sheet of steam being sometimes formed at the bottom of the boiler, at the commencement of ebullition. In this case the bottom becomes red hot, and the heat escapes by radiation, in place of being given off to the water. Hence Mr. Perkins was led to the idea of compressing the water in a close vessel with high pressure, in order to prevent ebullition, and compel the water to take up the heat.

In the ordinary condensing apparatus, where 1170 degrees of heat are absorbed in generating the steam, 1070 are lost by entering into the condensing water. Mr. Perkins, however, has contrived, after much labour, a method by which nearly *all the heat has been absorbed from the steam, and returned to the generator.*

The next object of Mr. Perkins was to save the heat that was lost in the common mode of supplying the furnace with air. In order to prevent the escape of the heat up the chimney, Mr. Perkins forces the air in at the top of the furnace. The effect of this is also to consume the smoke, which, in steam vessels, is a matter of considerable importance. In order to give an idea of the force of steam, and the saving of fuel, when it is raised under high pressure, Mr. Perkins makes the following observations.

"It is a well-known fact, that water does not boil under atmospheric pressure until it has been heated to 212°, after which all the heat that can be applied cannot increase the temperature of the steam or water. Now, add an artificial atmosphere by loading the escape valve (the surface of which is equal to a square inch) with 14 lbs. and it will receive

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* It has been stated to us, that Mr. Perkins has received the sum of L.36,000, from an enterprising individual, for a share of his patent.

250° of heat with a very little addition of fuel, and the pressure on the square inch will be doubled, or 28 lbs.; the mechanical action will not be double, yet it will be increased much more than the consumption of fuel. Let the valve be loaded with two additional atmospheres, or 42 lbs. and the temperature will be raised to 280°, and will again produce double pressure, or 56 lbs. in the inch, and so on. If the generator be made strong enough, as I have no doubt it may be, to withstand 60,000 lbs. load on the escape valve, the water would not boil, although it would exert an expansive force equal to 56,000 lbs. on the inch, and be at about 1170 degrees of heat, or cherry red. Water thus heated would, if it were allowed, expand itself into atmospheric steam, without receiving any additional heat from what surrounded it. It is not, however, necessary to heat the water to more than about 500° to have it flash into steam, if the generator be properly constructed."

Mr. Perkins's engine, as drawn under his own eye, is shown in Plate VIII. Fig. 1, where AA is the generator, now made of one piece of wrought iron, and placed in the furnace FFFF. The induction pipe BBB at its entrance into the generator is closed with a valve loaded with a variable weight L, and rising obliquely, terminates in a rotatory valve MM, which opens alternately a communication between the upper end of the induction pipe and the upper or under sides of the piston, which moves horizontally in the cylinder or pump KK. The arm NN fixed to the extremity of the piston, gives motion to the fly wheel OOO, which maintains the rotatory motion of the valve M. The eduction pipe G passes from the valve M through the condenser and collector of heat HH along CCC *u u* to the reservoir E filled with water under simple atmospheric pressure. The condenser HH is a cylinder of copper about 20 feet long and four inches interior diameter, from the bottom of which proceeds a pipe DD connected with the pump PP, whose piston is raised by the lever and variable weight R, at the end of which is a chain QQQ, by means of which it is wrought by the arm NN.

A tube I, I, I, I descends from the upper end of HH, and after forming several spiral turns round the bottom of the furnace F, it rises to the valve V, which opens upwards and downwards, and is turned with a variable weight W, with 50 atmospheres, or 700 lbs. on the square inch. From V the tube I I is continued to within an inch of the bottom of the generator A, as shown by the dotted line.

A tube SS proceeds from the top of the generator to the dial U which shows the number of atmospheres with which the machine works, and at the part T of the tube SS is the safety valve of copper, which is torn up when the pressure exceeds greatly the ordinary one. There is a small apparatus at Y, to furnish oil to the piston rod. The two tubes with stop cocks at X X allow the atmospheric air to escape from the spaces above and below the piston. The parallel motion apparatus, which is not shown in the figure, is fixed to the pillar Z.

The generator being now filled with water, up to the valve at B, water is also poured in at V, so as to descend into the pipe I, I, I, and flow into the generator till it is filled up to the valve. By working the pump P, water is driven by the pipe DD, into the condenser HH, which is filled to the top, the water redescending by the tube I,I,I, which it fills, and also the spiral of the ascending branch, till the compressed water, arriving at the valve V, shut by the weight W, opens the valve, and joins the rest of the water in V, I, I, I. It is almost unnecessary to say, that the cylinder K, the induction pipe BB, and the eduction pipe CC, which passes through the condenser, are empty. The induction pipe being now supposed to communicate with one of the sides of the piston, let the furnace be lighted. The heat will then rise through the water, and expand it, till it is nearly able to overcome the weight L. At this time the pump P is made to act so as to introduce a given quantity of water into the generator at its bottom. In forcing in this water, the force raises the valve, and a quantity of water equal to that admitted enters the induction pipe at B, and instantly *flashing* into steam, acts upon the piston, and drives it to one end of the cylinder. The eduction pipe being opened at this time, the steam, after having acted upon the piston, passes through the collector and condenser HH, giving out its heat to the water in HH, and passing, in a cold state, through CC to the reservoir E, from which it is re-pumped for use through the tube D. The motion of the piston having turned the fly-wheel, enables the rotatory valve M, which is put in motion by the fly, to shut the communication between the first side of the piston, and open a communication with the other side; so, that when a fresh quantity of water is forced into the generator, and a fresh quantity of steam flashed out of it, the piston is drawn back to its first position, and so on, a continued motion being thus kept up. The reader is no doubt aware that the water in the tube D coming from the pump P, and also the water in the condenser HH and the tube I I, is compressed with a weight equal to that exerted by W on the valve V. See the *Bibliothèque Universelle,* from which the drawing is taken, and the preceding description abridged, the original being drawn up by Mr. Gibbons Spilsbury, a friend of Mr. Perkins.

Mr. Perkins is, we learn, busily employed in fitting out a steam boat, with one of his engines, to go to Calcutta by the Cape of Good Hope. A steam boat from the Thames entering the Ganges will complete the triumph of this distinguished mechanician.

7. *M. Bracconnot's Process for making the Schweinfurt Green Dye.*

THIS green dye, which has acquired great reputation, and the secret of making which was known only to a manufacturer at Schweinfurt, has been analyzed by M. H. Bracconnot. He found it to consist of arsenical acid, deutoxide of hydrated copper, and acetic acid; thus approaching, in its ingredients, to Scheele's Green. After much difficulty, he succeeded in finding the following method of recombining these materials:

1. Dissolve *six* parts of sulphate of copper in a small quantity of warm water.

2. Boil *eight* parts of sulphate of potash of commerce with *eight* parts of oxide of arsenic, till carbonic acid ceases to be disengaged.

3. Mix this solution, while hot and concentrated with the former by a little at a time, continually stirring it till the efflorescence ceases. Care must be taken not to add the second solution, viz. the arseniate of potash, in excess. An abundant precipitate is formed, of a dirty yellow colour.

4. Add about *three* parts of acetic acid, or such a quantity of it that there may be a slight excess of it sensible, by its odour, after the mixture. By degrees the precipitate diminishes in volume, and at the end of a few hours there is spontaneously deposited a powder of a slightly crystalline texture, and of a very beautiful green.

5. Separate the supernatant liquor, (which, by remaining too long on the colour, might deposit oxide of arsenic, which would render it pale,) and then treat the coloured deposite with a large quantity of boiling water, to remove the last portions of arsenic which are not held in combination.

Bracconnot recommends the use of an arsenite of potash, well saturated with arsenic. Part of the arsenious acid remains in the mother waters; but this may serve for the preparation of Scheele's Green, which is commonly used for paper of an inferior quality. Bracconnot was of opinion that the addition of a small quantity of Scheele's Green to the mixture promoted the production of the superior colour. The colours produced by the preceding process of Bracconnot were regarded by several persons to be more lively than that of Schweinfurt.

8. *Dr. Liebig's Cheap Process of making the Schweinfurt Green.*

On account of the tediousness and expense of the preceding process of Bracconnot, Dr. Liebig has given the following as a preferable one, in the *Annnales de Chimie*, for August 1823.

Dissolve in a copper kettle, by heat, *one* part of verdigris, in a sufficient quantity of pure vinegar, and add to it an aqueous solution of one part of white arsenic. A precipitate of dirty green generally forms, which must be renewed by adding more vinegar, or till the precipitate is perfectly dissolved. After boiling this mixture, a granular precipitate will in a short time form, of the most beautiful green colour, which, being separated from the liquid, and well washed and dried, is the required colour. If the liquor, after this, contains copper, more arsenic may be added; and if it contains an excess of arsenic, more copper may be added, and the process repeated. When the liquid contains an excess of acetic acid, it may be employed in dissolving more verdigris.

The green prepared in this way has a bluish shade; but the arts often require a deeper shade, somewhat yellowish, but of the same beauty and elegance. To produce this, dissolve a pound of common potash in a sufficient quantity of water, and having added to it ten pounds of the colour prepared as above, warm the whole over a moderate fire. The mass will soon acquire the required shade. If it is boiled too long, the colour will approach to Scheele's green; but it always surpasses it in beauty and splendour. The remaining alkaline fluid may be used in the preparation of Scheele's Green. Ann. de Chimie

9. *Bevan's Experiments on the Adhesion of Nails.*

In order to determine the force with which nails adhere to wood in which they are driven, Mr. B. Bevan constructed a machine for measuring the force of tension with extensive power. He applied it to the extraction of nails of different lengths, from a quarter of an inch to two and a half inches.

The following were the results obtained by Mr. Bevan, when the nails were forced into dry Christiana deal, at right angles to the grain of the wood.

Kind of Nail.	Number to the lb. avoird.	Inches in length.	Inches driven into the wood.	Pounds required to extract them.
Fine sprigs	4560	0.44	0.40	22
Ditto	3200	0.53	0.44	37
Threepenny brads	618	1.25	0.50	58
Cast iron nails	380	1.00	0.50	72
Sixpenny nails	73	2.50	1.00	187
Ditto	——	——	1.50	327
Ditto	——	——	2.00	530
Fivepenny	139	2.00	1.50	320

He likewise found, that the progressive depths to which a sixpenny nail was forced into dry Christiana deal, by simple pressure, were as follows:—

A quarter of an inch	24 lbs.
Half an inch	76
One inch	235
One and a half inch	400
Two inches	610

See the *Philosophical Magazine and Journal*, vol. lxiii. p. 168.

10. *Mr. Church's Printing Machinery.*

The printing apparatus invented by Mr. Church, of the Britannia Works, Birmingham, forms perhaps the most extraordinary combination of machinery that has for a long time been submitted to the public. It consists of three pieces of mechanism. The *first* of these has for its object the casting of metallic types with extraordinary expedition, and the arrangement of them for the compositor. By turning a handle, a plunger is made to displace a certain portion of fluid metal, which rushes with considerable force, through small apertures, into the moulds and matrices by which the types are cast. The farther progress of the machine discharges the types from the moulds, and causes them to descend into square tubes, having the shape of the types, and down which they slide. It then brings the body of each type into the position required for placing it in the composing machine; and when the types have descended in the guides, they are pushed back by the machine into ranges, each type preserving its erect position. The machine then returns into its former state, and the same operation is renewed. The construction of the mould-bar is the most striking portion of the machine.

The *second* machine selects and combines the types into words and sentences. The several sorts of types are arranged in narrow boxes or slips, each individual slip containing a great number of types of the same letter, which is called a file of letters. The cases containing the files are placed in the upper part of the composing machine; and by means of keys like those of a piano-forte, the compositor can release from any file the type which he wants. The type thus liberated is led by collecting arms into a curved channel, which answers the purpose of a composing stick. From this channel they may be taken in words or sentences, and formed by the hand into pages, by means of a box placed at the side of the machine.

The *third* machine, for taking off impressions from the types, evinces much ingenuity; but cannot be understood without several drawings.

After the types have been used, and the requisite number of impressions obtained, they are remelted and recast as before, so that every sheet is printed with new types.

A general description of these machines, in their first state, has been given by Mr. Newton in his *Journal of Arts;* but the inventor has, we learn, made great improvements upon them, for which new patents are now in progress. An account of these new machines will, we understand, be given, along with drawings of them, under the article PRINTING MACHINERY, in vol. xvii. of the *Edinburgh Encyclopædia,* about to appear.

ART. XXVIII.—ANALYSIS OF SCIENTIFIC BOOKS AND MEMOIRS.

I. *Journal of a Second Voyage for the Discovery of a North-West Passage from the Atlantic to the Pacific, performed in the years* 1821-22-23, *in his Majesty's ships Fury and Hecla, under the orders of* Captain W. E. PARRY, R. N. F. R. S. 1824, 4to. pp. 570.

THE long absence of Captain Parry, for two successive winters, and the various rumours of success which preceded his return, conspired to throw an interest round the late expedition which the great body of the public had ceased to feel in these annual excursions to the icy regions. As long as an arctic winter was invested with its ancient horrors, and threatened the navigator with perils unnamed and unendured in more southern regions, the love of the marvellous kept up in the public mind a certain degree of toleration for expeditions of discovery. But when the liberality of our government, and the admirable skill which presided over these naval equipments, had removed all the discomforts of a northern voyage;—when expeditions returned without the loss of a single man;—and when the officers and crew had scarcely landed before they volunteered on a fresh voyage, that approbation which the imagination alone had given was withdrawn, and the extravagance of our government was severely censured, even by men who, in other respects, were feelingly alive to British interests.

These observations have been suggested by the extraordinary apathy under which the new expedition has again left our shores. Beyond the little circle limited by private friendship and local interests, no feeling has been excited, and the most eminent of modern navigators has devoted himself to another exile with less public sympathy than if he had gone out for oil to Spitzbergen, or for peltry to Hudson's Bay.

This state of public feeling we cannot but deplore, for the sake of science; but however loud be its expression, we trust that those who have the direction of our national resources will never think that a small portion of them can be misapplied in promoting geographical discovery, as well as in sustaining a spirit of enterprise among our seamen. The extension of our commercial relations, and even the triumphs of our power, though necessary and legitimate objects of national ambition, are not of such paramount importance as to exclude the more liberal objects of scientific research. In the one, the glory and the advantages are confined to ourselves; but, in the other, we labour for the civilized world, and associate the name of our country with the only species of national renown which will be as permanent in its duration as it is generous in its character, and boundless in its influence.

The equipment of the Fury and the Hecla for the late voyage to Hudson's Straits exhibited many instances of great sagacity and judgment. Contrary to the usual practice, the ships were in every respect of the same size; so that, by this arrangement, the supply of stores might be considered as almost doubled. The uniform distribution of heat throughout the ships was effected by a stove fixed on the orlop deck, and constructed on purpose, by Mr. Sylvester. In order to save room, a greater quantity of preserved meats and concentrated soups was furnished. The spirits were, for the same reason, supplied at 35 per cent. above proof. The whole of the vinegar was concentrated to 1-7th of its ordinary bulk, and kiln-dried flour, which occupies only 1-3d of the space of biscuit, was substituted for one-half of the proposed supply of that article. Thus equipped for three years, the Fury and Hecla left the Little Nore on the 8th of May, 1821. They entered Davis's Straits about the middle of June; and, during the rest of the month, kept close to the margin of the ice off the entrance to Hudson's Strait, having fallen in with the Esquimaux at the Savage Islands, about the 21st. The greater part of the month of July was spent near the entrance to Hudson's Strait; and, by the beginning of August they had reached the upper end of it. Passing the north-eastern coast of Southampton Island from the 5th to the 15th, they entered Frozen Strait on the 20th; and, proceeding by the Duke of York's Bay to Repulse Bay, Captain Parry determined the non-existence of a passage to the westward through the latter. He therefore directed his course to the N.E. passing Duckett Cove, and Vansittart's Island about the end of August.

The expedition anchored about the 6th September in Lyon's Inlet, and after surveying it in boats, and connecting its shores with those of Gore Bay, the ships arrived in a bay on the south side of Winter Island on the 8th of October, where they were placed in security for the winter.

Having prepared a theatre for the amusement of the crew, and established schools, (in which every man on board, who could not read before, learned to read his Bible before the return of the expedition,) and a portable observatory; the winter of 1821-22 was spent in nearly the same manner as during Captain Parry's former voyage. The routine of duty and amusement was however fortunately diversified by the arrival of a party of Esquimaux on the 1st of February, with whom the officers and men lived in the greatest intimacy. An account of the manners and customs of this wretched tribe, and of a hunting expedition which was performed in company with them, forms an interesting part of Captain Parry's narrative.

On the 15th March, Captain Lyon set out with a party on a short excursion across Winter Island, but in consequence of a sudden diminution of temperature, and a hard gale from the N. W. accompanied with a snow drift, the party were exposed to the severest sufferings, and with great difficulty returned to the ships on the 8th of May. When the weather had become more favourable, Captain Lyon and Lieut. Palmer took charge of another expedition to the north-west end of Winter Island, and along the south-east part of Melville Land, passing through Blake Bay, and Palmer Bay, to Point Elizabeth, when they were compelled to return by the failure of their provisions, and the blindness of several of the party.

Towards the end of June, Captain Parry began to cut a canal for the liberation of the ships, but owing to various untoward circumstances, he was not able to leave Winter Island till the 2d of July, when he directed his course to the north. The openness of the ice enabled them to pass, without difficulty, along the western shore of Melville Peninsula, past Barrow River, Cape Penrhyn, and Cape Brown, and Cape Jermain; and about the middle of July they arrived off the Strait of the Fury and the Hecla. Being opposed in their progress, however, by a fixed barrier of ice, they landed on the Island of Igloolik, and had various interesting communications with the Esquimaux.

The expedition then proceeded to examine the narrows of the Strait of the Fury and the Hecla, passing Ormond Island, Liddon Island, and Amherst Island, at the west end of which, it was deemed prudent to stop. Various land journeys, however, and excursions in boats, were performed; and Captain Parry succeeded in discovering the sea expanding to the westward, beyond Capes Hallowell and Englefield, which terminate to the west the Strait of the Fury and the Hecla. In an excursion with Mr. Bushnan, Captain Parry went to the head of Whyte's Inlet, on the north side of the strait, which was both the most northern, and the most western point which was visited during the voyage. It is situated in 70° 11′ of north lat. and 84° 53′ of west longitude.

After examining the coast to the north-eastward, and a short excursion to Quilliam Creek and Crozier River, Captain Parry proceeded with the ships to Igloolik to look out for winter quarters. The ice appearing to be permanently fixed for the winter, Captain Parry proceeded, on the 17th October, to saw out a passage for the ships to the land. Thirteen days were occupied in this laborious operation, and, after cutting a canal 4843 feet long, out of ice nine inches thick, the ships were again completely moored for a second winter, which the usual amusements and a constant intercourse with the Esquimaux enabled the ship's company to spend without ennui.

On the beginning of August, 1823, the dissolution of the ice allowed the expedition to resume its labours; but from various causes, which it is needless to detail here, it was deemed prudent to return immediately to England, where Captain Parry arrived in safety in the middle of October, 1823.

From this brief narrative of the proceedings of the expedition, we shall now proceed to the more appropriate object of this analysis, namely, an account of the scientific results obtained during the voyage. As the Appendix, containing all the results in detail, is not yet before the public, we are not enabled to prepare this analysis in the way we could wish.

1. *Magnetical Observations.*

From the proximity of the magnetic pole to the regions visited by Captain Parry, his magnetical observations were anticipated with a higher interest than any of the other secondary objects of his voyage. Nor have these anticipations been disappointed. The comparison of the magnetic declinations with those made during the last voyage, possess a peculiar interest, as they enable us to fix with considerable certainty the position of the principal magnetic pole in the northern hemisphere. The following table of observations has been gleaned from the charts, and from different parts of the narrative.

Table of Variations of the Needle in 1821 *and* 1822.

North Lat.	West Long.	Variation.	North Lat.	West Long.	Variation.
61°15′	64°45′	52°45′ W.	66°24′33″	84°39′50″	56°19′52″
61 10	65 15	52 56	66 46	84 20	50 9
61 30	65 50	51 39	66 37	84 13	57 3
62 31 30″	69 57 17″	52 37	66 32	83 48	54 46
65 0	79 30	52 11	66 12	83 13	56 18
65 25	82	55 5 30	66 56	81 38	62 17
65 30	83 15	53 49	67 13	81 7	70 28
65 35	84 10	50 34	69 25	80 0	79 20 52
65 28 13	84 40	50 18 26	69 33 27	81 9	82 21 51
65 20 56	84 57 4	46 25	69 32 10	81 23 6	86 5 43
65 28	84 10	47 34	69 33	81 40	87 30
66 30 58	86 30 20	48 32 57	69 35	82 5	88 51
66 12 36	84[*] 44 2	52 19 48	69 49	83 30	89 18
66 11 25	83 10	56 18 30			

[*] This is printed by mistake 86° in Captain Parry's work.

Table of the Dip of the Magnetic Needle in 1821 *and* 1822.

North Lat.	West Long.	Dip.	North Lat.	West Long.	Dip.
61° 13′ 5″	64° 5′ 10″	83° 58′ 51″	66° 11′ 25″	83° 10′	87° 49′ 39″
65 28	85 10	87 28	66 56	81 38	87 47 13
66 30 58	86 30 20	88 7 28	69 33 27	81 9	87 37 9
66 12 36	84 44 2	87 31 6	69 32 10	81 23 6	88 6 26
66 37	84 13	87 51	69 49	83 30	88 21

The preceding observations, when compared with those made by Captain Parry in 1819, afford very important data for determining the position of the magnetic pole. The following observations were made on the 22d and 24th August, 1819.

North Lat.	West Long.	Variation.
74° 40′	91° 47′	128° 58′ 7″ West.
75 9	103 44	165 50 9 East.

Hence it follows, that about the end of August, 1819, the principal magnetic pole was situated between the meridian of 92° and 102°, or, to take a round number, not far from 95° of W. Long.

Now, according to Hansteen, the principal magnetic pole in August 1819 should be in 89° 29′ of W. Long. and 69° 38′ of N. Lat. whereas in 1821-22, it should be in 89° 0′, and 69° 36′.

If we now compare Captain Parry's measure of the variation, viz. 46° 25′ taken in 65° 20′ 56″ of N. Lat. and 84° 57′ 4″ of W. Long. with the variation of 89° 19′ taken in 69° 49′ of N. Lat. and 83° 30′ of W. Long. it is obvious that the magnetic pole must be nearly in the parallel of 70°, and the meridian of 90° only about 5° to the west of Whyte's Inlet. Had Captain Parry, therefore, been able to pass by Cape Hallowell to the west, he would have sailed across the magnetic pole, which he will no doubt accomplish in his present voyage, while pursuing Prince Regent's Inlet.

2. *Meteorological Observations.*

The meteorological observations made by Captain Parry are not less interesting than the magnetic ones. His residence during a year in two different latitudes, and the accuracy with which his observations were made, (having been recorded every two hours,) give a value to the general results which could scarcely have been anticipated.

The following table, which Mr. Edwards, the principal medical officer of the Fury, was so kind as to favour us with, presents the results for 1821-22, and 1822-23, in relation to the two winter positions of the expedition. *

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* It is necessary to remark, that the column containing the mean results does not give the mean of the maximum or minimum either of the day or the month, but the daily mean of the twelve daily observations.

Table of the Monthly and Annual Temperature, on board the Fury, for Two Years.

About N. Lat. 66° Long. 83° W.				N. Lat. 69½° Long. 82½° W.			
	Max.	Min.	Mean.		Max.	Min.	Mean.
1821.				1822.			
August -	+ 48°	+ 28	+ 36.6	August -	+ 50	+ 27	+ 33.5
September -	+ 42	+ 20	+ 31	September -	+ 37	+ 11	+ 24.4
October -	+ 32	— 13	+ 12.5	October -	+ 29	— 9	+ 13.3
November -	+ 28	— 20	+ 7.7	November -	+ 8	— 32	— 19.3
December -	+ 2	— 29	— 13	December -	— 10	— 43	— 27.8
1822.				1823.			
January -	— 6	— 37.5	— 23	January *	+ 22	— 50	— 17
February -	— 4	— 37	— 25	February *	+ 21	— 43	— 20.5
March -	+ 13	— 35	— 11.6	March -	+ 4	— 41	— 19.7
April -	+ 29	— 12	+ 5.5	April -	+ 32	— 25	— 1.7
May -	+ 46	— 3	+ 23	May -	+ 50	— 8	+ 24.8
June -	+ 50	+ 20	+ 34	June -	+ 52	+ 8	+ 32.2
July -	+ 54	+ 34	+ 36.5	July -	+ 59	+ 30	+ 40
The Year	+ 54	— 37 5	+ 9.5	The Year.	+ 59	— 50	+ 5.6

Hence we have :

The mean annual temp. of N. Lat. 66° 11′, and W. Lon. 83½° + 9° 5 Fahr.
——————————— 69 19, 82½ + 5 6

From the observations made by Captain Parry, he concludes that the effect of the warm atmosphere of the ship amounted to 3°, and that the mean results must be diminished by that quantity. Hence we have

	Lat.	Temp.
Mean temperature of Melville Island, -	74° 45′	— 1° 7
——————— of Igloolik, - -	66 11	+ 6 5
——————— of Winter Island, -	69 19	+ 2 6

If these results had been the average deductions of several years observation, we should have been led to believe that Melville Island was to the north of the pole of maximum cold, and that this cold pole was still nearer the magnetic pole than the position which we had formerly assigned to it.

In this uncertainty, it became interesting to possess the mean temperature of another parallel farther to the west; and as numerous observations were made by Captain Franklin and Dr. Richardson near Fort Enterprise, in the parallel of 64°, and the meridian of 110°, we requested Dr. Richardson to favour us with the temperature of that parallel as deduced by himself, which he had the goodness to do in the following note.

" The mean temperature from 1st September, 1819, to 1st September, 1820, was +38° 72 Fahr. September and October were occupied in travelling into the interior upon nearly a W. S.W. course, or from York Factory in Lat. 57° to Cumberland House in Lat. 54°. We were stationary at the latter place until June 1820; but from June 4th to August 20th, we travelled near the 110th meridian to Lat. 64° 30′. At Fort Enterprise, in this latitude, we were stationary for the remainder of August, which completes the year. We continued stationary at Fort Enterprise from September 1820 to June 1821; but from the 20th of June to the end of August we were occupied in travelling to the north as far as 68° 30′, and in returning a short distance. The temperatures for July and August of that year were lost; but by using the temperatures for these months of the preceding year, the *mean temperature of a parallel, a very short way to the south of Fort Enterprise,* will be obtained. The mean thus got is +14°.21 Fahr."

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* During these two months large bodies of ice separated at no great distance from the land, leaving a large expanse of open water.

If we now combine this result, as deduced by Dr. Richardson, with those given above, we shall obtain a confirmation of the supposition, that the Pole of maximum cold lies within a quadrilateral figure, formed by joining the four points of observation, viz. Fort Enterprise, Melville Island, Igloolik, and Winter Island. This, however, is only a supposition, as the variations of temperature in high latitudes are so great in different years, that we cannot consider the numbers above given as accurate mean results. Observations continued for many years, on more distant isothermal lines, are better calculated to give the accurate position of the pole of maximum cold; while observations made near the pole itself are extremely valuable in fixing its probable temperature.

When we consider that + 32° was long believed to be the lowest temperature, or that of the pole of the globe, we cannot but attach a high degree of value to observations which demonstrate, as those of Captain Parry do, that that temperature must be below — 3° of Fahr.

To these observations we may add the very interesting comparison which Captain Parry has given of the mean temperature of the atmosphere during six months of each of the three winters passed in the Polar Regions, during this and the preceding expedition:

Months.	Melville Island. Lat. 74° ¾ 1819-20.	Igloolik. Lat. 69° ⅓ 1822-23.	Winter Island. Lat. 66° ¼ 1821-22.
October,	— 3°.46	+ 12°.79	+ 12°.51
November,	— 20 .60	— 19 .37	+ 7 .75
* December,	— 21 .79	— 27 .80	— 12.94
January,	— 30 .09	— 17 .07	— 22 .96
February,	— 32 .19	— 20 .41	— 24 .97
March,	— 18 .19	— 19 .75	— 11 .64
Mean,	— 21 .04	— 15 .27	— 8 .71
Corrected Mean Temperature, *	— 24 .04	— 18 .27	— 11 .71

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* "The corrected mean temperature," says Captain Parry, "is the registered temperature, with a deduction of 3° for the warm atmosphere of the ship." P. 421.

The Aurora Borealis did not present any very striking phenomena during either of the two winters. In the winter of 1821-22 it issued more frequently from the south-eastern quarter than from any other. It appeared very brilliant on the 2d and the 14th of December, and the intensity of the light sometimes exceeded that of the moon in her quarters. At one time in the evening, and before the phenomena had assumed the regular arch-like form, there was observed about the zenith a radiated appearance, which changed suddenly into an irregularly circular band of light like a ribbon, and then again returned to the radiated form. The commencement of the Aurora in the S.E. quarter of the heavens, and the arch-like form, were two of its almost invariable peculiarities. The legs of the arch were usually situated somewhere between the east and west points of the horizon, and almost always occupying the southern side of the heavens.

In the winter of 1822-23, the Aurora rarely occurred, and made a poor display when it did appear. It was almost always seen between E.S.E. and W. S. W. tending to form an irregular arch, with coruscations shooting towards the zenith. The electrometer and magnetic needle were often watched during the aurora, but they were never affected by it.

Hydrographical Observations.

Various experiments were made on the temperature of the sea at different depths; (see pages 304 and 484;) but it seldom differed a degree from that of the surface water. On the 5th August, 1822, water in 57 fathoms deep was at 32½° and that of the surface 30½°.

The following results were obtained by Mr. Fisher respecting the specific gravity of the sea water.

1822.	Spec. Grav.	Temp. when weighed.		Spec. Grav.	Temp. when weighed.
Aug.	1.—1.0265	55°	Aug.	7.—1.0261	51½°
	4.—1.0243	56		26.—1.0263	52
	5.—1.0286	40		27.—1.0256	50

At Winter Island, the mean time of high water on
full and change days was . . . 12^h 11^m
The rise of the highest spring tide, . . . 15 feet 8 inches.
lowest neap tide, . . 3 . 1

The flood came from the northward, and ran at spring tides between two and three knots.

II.—*Experiences sur le Remou, et sur la Propagation des Ondes.* Par George Bidone. From the twenty-fifth volume of the *Memorie della Reale Accademia delle Scienze di Torino,* p. 21—112.

The first part of this long and elaborate memoir contains an experimental examination of the *Remou,* or the phenomena which take place when a canal is dammed up with a bar or dike, so as to cause the water to heap up behind the dike. In this case the water must obviously rise till the quantity of it which passes over the dike is equal to the regular expense of water in the canal. When this elevation is attained, the canal is again reduced to a permanent state, conformable to the new condition of its bed. In this case the reflux of the water has taken place over a certain length in front of the dike, and all the sections of the current taken in any part of this length, have a greater height than they had before the establishment of the dike. This length, reckoned from the dike, is called the extent of the *remou*. Among the results given by these experiments, M. Bidone has particularized the two following:—

1. The extent of the remou, or the elevated mass of water, is always less than the distance, where a horizontal line, drawn from the highest part of the remou, would meet the surface of the canal in front of the dike.

2. That the surface of the water over the whole length of the remou is always convex upwards, the convexity being very slight in the intermediate part of this length, and augmenting rapidly near its two extremities, where it becomes very considerable.

After detailing, at great length, the various results of experiment, M. Bidone proceeds to investigate a formula from which he can calculate approximately the extent and height of the remou for a given dike, and he gives equations for computing the velocity with which the remou will propagate itself when the canal is entirely dammed up.

In this inquiry M. Bidone had an opportunity of taking accurate measures of the *velocity of running water*, and he has compared the results with the simple but rigorous formula which M. Eytelwein has published in the *Memoirs of the Academy of Berlin* for 1814 and 1815. This formula, founded on the theory of the linear motion of fluids, combined with the law of the resistance which the bottom and sides of the canal oppose to this motion, is the most perfect that has yet been given. Calling

c The mean velocity of the current.

g The space described by a heavy body in a second, $= 15.0979$ Paris feet.

a The section of the current.

p The perimeter of the section.

l The length of the bed of the canal, to which corresponds the fall h.

$\frac{h}{l}$ The declivity of the canal, reckoned from the surface of the water.

We have Eytelwein's formula.

$$c = -(0,0067675)\,g + \sqrt{(557,798)\,g \cdot \frac{a\,h}{p\,l} + (0,0000458)\,g^2}$$

The results of M. Bidone's experiments were,

Measured velocities, by dividing the expense by the section.	Velocities computed by the formula.	Differences.
Feet.	Feet.	Feet.
4.2055	4.1798	— 0.0257
4.8817	4.8211	— 0.0606
5.2092	5.2024	— 0.0068

The most laborious part of this memoir is devoted to the propagation of waves, for the purpose of comparing the results with the theory of M. Poisson. This comparison presents a striking confirmation of the theory of the French philosopher, but we cannot enter upon any analysis of this part of the memoir.

The *propagation of motion downwards in water* does not seem to have been previously examined; and M. Bidone appears to have been the first who established this fact by undoubted experiments.

The canal which he used for this purpose, viz. CDGH, Plate VIII. Fig. 7, was placed close to a reservoir AB, whose depth was greater than that of the canal. At this end of the canal there was a groove CD, into which could be fixed a vane, or a sluice, at any required height above the bottom of the canal. The aperture at D had all the width of the canal, and any communication between the two masses of water divided by CD, could only take place through that aperture.

The level of the stagnant water being GSCAE, CD its depth in the canal, and the height of the aperture in D being known, he produced waves at S by a cylindrical segment, and he observed that they showed themselves on the surface AE placed on the other side of the sluice. When the distance of the centre of the waves S was 6, 12, and 18 feet from C, the depth CD 23 inches 9 lines, and the height of the aperture D above the sluice 9 lines, waves were seen propagated along the surface AE beyond the sluice, viz. the first, the second, and the following waves, till all the surface AE was briskly agitated with stronger waves, and by their reflexion against the side EF, and also by their mutual impulse. Exactly as in an open canal, the first wave produced by the immersion of the segment at S has its profile hollow in relation to the primitive level of the surface of the liquid: in like manner, the first wave which shows itself at the surface AE beyond the sluice had its profile hollow in relation to the same level. The arrival of this wave at the surface AE was so visible, that he could mark the instant at which it appeared at a given point A of that surface. When CD was 21 feet 8 inches, SC 3 feet, the height of D 1 inch, and AC 1 foot 6 inches, the first wave took 2 seconds to arrive at A, through D, whereas it would have taken only 0″.96 if CD had been removed.

M. Bidone concludes his memoir with some experiments *on the form of waves produced by triangular, square, and elliptical discs.* He had occasion to examine the form of waves produced by different discs, both when the surface of the water was struck with the discs, and when the immersed discs were suddenly and perpendicularly withdrawn from the same surface. The triangular disc *m*, Fig. 8, was six inches 3 lines on the side: the square disc was 9 inches 6 lines; and the elliptical disc had its great axis 18 inches 6 lines long, and its smaller axis 7 inches. The lines *a b c* in Fig. 8, represent the apparent figure and motion of the waves all round the triangular disc, and as they appear to the observer, while he follows with his eyes all round the disc, and at a little distance from its perimeter, a series of waves, which, from their profile, he considers as belonging to the same group, and moving on the same lines all round the disc. For triangular and square discs this series of waves has a figure the reverse of that of the discs. In the case of the elliptical discs, the same series of waves has a figure which widens rapidly in the direction of the smaller axis, and soon becomes circular at a small distance from the disc.

III. *On the Formation of Dew on Metallic Surfaces.* By GEORGE HARVEY, Esq. F.R.S.E.

MR. HARVEY has published, in the 33d Number of the Quarterly Journal of Science, a long paper relating to this interesting subject, in which he has confirmed many of the curious results first discovered by Dr. Wells, and by repeating his experiments under an extended form, and under very varied circumstances of the atmosphere, has added many singular facts to our information on the subject.

The investigation of the phenomena of dew embraces many interesting inquiries; and although the circumstances under which experiments of the kind are sometimes performed, are not of the most comfortable kind, still, from the peculiarly interesting nature of the appearances disclosed, and the trains of valuable and interesting speculation to which they give birth, the philosophical inquirer is amply repaid for the inconvenience he undergoes. We hazard these remarks, because we are sure that the author of the paper before us must, in common with his ingenious and indefatigable predecessor in this path of inquiry, have been frequently exposed to the chilling influences of the midnight sky, in witnessing the phenomena they have recorded.

In the paper here alluded to, it was one of Mr. Harvey's objects to trace the gradual steps by which dew is deposited, under favourable circumstances of the atmosphere, on the surface of metallic paper, when placed in contact with a body which attracts dew powerfully. When silver paper, for example, was attached by mucilage to a slight wooden frame, Mr. Harvey remarked, that the dew was *first* deposited in small elementary triangles, at the corners of the square, similar to the right angled triangles into which the metallic paper was divided by its contact with the cross; and which, by gradually augmenting in quantity when the atmosphere was favourable, finally covered the whole of the metallic surface, *excepting the parts in contact with the wood,* and which were perfectly *dry.* The fact respecting the dry portions of the metallic paper was first observed by Dr. Wells; but Mr. Harvey, by observing the phenomena more narrowly, has placed the subject in a very interesting light, and illustrated it by drawings descriptive of the various appearances.

An interesting circumstance occurred during the prosecution of these experiments. Early in the month of April, at nine P. M. as Mr. Harvey remarked, a large pane of glass was placed on the green herbage, and on it squares of gold and silver paper attached to crosses. The clear and transparent sky, joined to the perfectly tranquil state of the atmosphere, indicated the possibility of a copious deposition of dew. At six the next morning, the grass exhibited the appearance of a thick hoar frost, and the moisture which had been formed on the upper and under sides of the glass during the night presented coats of transparent ice. On referring to the squares of metallic paper, that of gold was found removed from the glass on which it had been placed the preceding evening to the distance of six feet; its change of situation having been probably produced by the force of some breeze during the night. The metallic side was in contact with the grass, and on taking it up, it presented four beautiful triangles, completely covered with innumerable particles of frozen dew. Those parts of the metal which had their inferior surfaces in contact with the wood, exhibited the perfect and well-defined form of a cross. The appearance of the crystalline triangles, when contrasted with the golden surface of the cross, was extremely beautiful; and it was remarked, that as the gradually increasing warmth of the morning dissolved the crystals of dew, the moisture was still confined to the same triangular surfaces; thus preserving completely the form of the cross.'

Mr. Harvey has also given some drawings illustrative of the comparative sizes of the particles of dew deposited on different metals, and which is a part of the subject worthy of a farther and more extended examination. In one experiment, Mr. Harvey found, when equal squares of lead, zinc, brass, copper, and tin were presented to the influence of a clear sky, that, at sunrise the next morning, the particles of dew on the different surfaces were found of variable magnitudes, those on the lead being the largest; the particles on the zinc next in size; the particles on the brass still smaller, but much more numerous; but the copper and tin, particularly the latter, had only the lustre of their surfaces just dimmed, by the abundant moisture of the air. The relation, however, between the particles on the lead and brass, was inverted on another night, in consequence of the metals being placed on grass, whereas in the former experiments they rested on a vitreous surface.

In another experiment, a plate of polished tin was placed on long grass, its weight necessarily compressing the herbage on which it rested, so as to surround the polished surface on all sides by grass, reaching twelve inches above it. At eighteen inches above the ground, or two inches above the average height of the grass, a similar plate was placed on slender props. The next morning, the plate surrounded by the long grass had its superior surface completely covered with minute but distinct particles of moisture, whereas that elevated above the grass was perfectly dry. The result of this experiment would seem, at first view, completely opposed to a principle adopted by Dr. Wells, viz. "That whatever diminishes the view of the sky, as seen from the exposed body, occasions the quantity of dew which is formed upon it to be *less* than would have occurred if the exposure to the sky had been complete;" since the plate raised above the grass had its surface exposed to the entire canopy of the sky, whereas the view from the other was confined to a comparatively small circular space in the zenith of observation. But as Mr. Harvey observes, the maxim of this ingenious philosopher is evidently limited to the consideration, that the bodies are in other respects similarly circumstanced, and which was not the case in the experiment here alluded to, since one of the plates was not only in contact with the herbage, but also surrounded by it; whereas the other was completely detached. That the *quantity* of herbage also has a considerable effect, is known from the curious fact observed by Mr. Six, that the temperature of short grass is always greater than that of long grass.

Mr. Harvey has also given another figure to illustrate the interesting appearances of dew gradually deposited on the metallic side of gilded glass. At the time it was presented to the chilling influence of the clear transparent sky, dew had formed on glass in a shady place, three quarters of an hour before the departure of the solar orb. A mild and gentle breeze prevailed, but no perceptible change took place in the metallic surface until eight, an hour and a half after its exposure; when minute particles of dew were visible at its leeward end, and which gradually increased for two hours towards the middle part of the gilded surface. Distinct drops were also deposited at the same time near the windward end; and as the particles increased in size round three of the edges, other minute drops were successively deposited nearer the middle; and it was observed, that they accumulated with most rapidity on the leeward sides. At midnight an oval portion of the metal was found free from dew.

Many other curious facts are recorded in these papers, to which we refer the reader.

IV.—*The History of Ancient and Modern Wines.* Lond. 1824, 4to. pp. 408.

With the exception of the History of Wines by Bacon, which is now more than 200 years old, and a similar work by Sir Edward Barry, published about 50 years ago, the English language could boast of no work upon this important branch of domestic economy. This desideratum in our literature has, we think, been well supplied by the present work, which, the preface informs us, is from the pen of Mr. Alexander Henderson.

In the introductory chapter, our author considers the principles of fermentation, and the constituents of wine in general. He treats of the culture of the vine,—the management of the vintage,—the secondary fermentation,—and the diseases of wine; and the information which he has given on all these subjects is not only selected with judgment, but marked with the chemical knowledge of the author.

The vegetable extract existing in the recent or expressed juice of the grape, is considered by Dr. Macculloch and M. Thenard as the proper fermentative principle. The last of these chemists supposes that this extract tends to excite fermentation in consequence of its having the power of abstracting, by means of its hydrogen and carbon, a portion of oxygen from the sugar of the must. In this way the divellent affinities of the ingredients of the sugar are brought into action. A part of its oxygen and carbon is evolved in a gaseous form, while its hydrogen and the remaining oxygen and carbon are converted into alcohol. The temperature at which this change takes place is about the 65th degree of Fahrenheit. When the fermentation in the vat has ceased, and the wine has been drawn off into casks, a secondary or insensible fermentation takes place, and often continues for many years. This arises from the mutual action of a portion of the sugar which remains undecomposed, and some of the extractive matter which still exists in the solution. This change ameliorates the wine by promoting a more intimate union of the alcohol with the acid and mucilaginous principles, the tartar is precipitated, and the aroma and flavour become more apparent.

When the wine is supposed to be sufficiently matured, it is then freed from its lees; and in order to prevent a fresh fermentation, it is *sulphured*, or sulphur matches are burnt within the cask. Many wines require to be still farther clarified or *fined*, by introducing isinglass, or white of eggs, or gum arabic, or fuller's earth, or powdered marble, or heated flints, which, by uniting, either chemically or mechanically, with the matters that render the wine turbid, precipitate them to the bottom.

From these preliminary objects Mr. Henderson proceeds to the first part of his work, *on the History of Ancient Wines*, in which he treats of the vineyards of the ancients,—of the management of their vintage, and the preparation of their wines,—of their wine vessels and wine cellars,—of the varieties and qualities of the Greek, Roman, and Oriental wines,—of the methods which they employed for diluting and cooling their wines,—and of the use of wine at their banquets.

In the second part, *on the History of Modern Wines*, our author gives a very full account of all the modern wines which have attained any celebrity; and he has added three interesting chapters on certain modes of keeping and mellowing wines,—on the mixture and adulteration of wines,—and on the dietetic or medical qualities of wine.

The method of mellowing wines which Mr. Henderson here describes, is that of M. Soemmering of Munich, which has been successfully tried on a small scale in this country, and which deserves more of the public attention than it has received.

"Dr. Soemmering," says our author, "found that certain substances allow the aqueous part to escape more freely than the alcohol; while others again are permeable to the latter fluid, but resist the passage of water; the respective evaporations, however, depending, in some degree, on the strength of the spirit. For instance, a spirit consisting of equal parts of pure alcohol and water, inclosed in a close vessel, the mouth of which was closed with a piece of bladder, lost more water than alcohol; but when raised to 62°, it passed through the bladder unchanged, and the same was the case when a spirit of 42° was placed in a vessel with an air-tight cover of fir wood. In glasses that were protected by coverings of elastic gum, on the other hand, the strength of the contents was diminished, in consequence of the greater relative evaporation of the alcohol. From the facts thus established, Dr. Soemmering conceived the idea of improving wines, by subjecting them to a similar process. He accordingly filled a common Bohemian wine glass with Asmanshauser, covered it with a bladder, and allowed it to remain 81 days undisturbed, in a warm and dry room. During this time one-half of the quantity inclosed had evaporated, and the residue was not only free from all mould, motheriness, or acidity, but had acquired a more spirituous, and, at the same time, a more mellow and agreeable flavour and aroma than the wine originally possessed. The colour was considerably heightened: a crystalline coat or film had formed on the surface; a deposit of crystals had also taken place at the bottom of the glass, and the proportion of alcohol was exactly doubled, the aræometer showing an increase from 4.00 to 8.00. The repetition of the experiment was attended with similar results, proving that wines thus treated may acquire, in the course of a few weeks or months, the same degree of mellowness which they only attain in as many years, when kept in the usual way.

It may perhaps be objected, that the great loss occasioned by this process renders it inapplicable to the melioration of wines on a considerable scale. But it is observable, that in the experiments just described, only a small quantity of fluid was employed, and the surface was proportionably large. Had it been exposed in a narrow-mouthed vessel, the evaporation would necessarily have been less. Some Rhenish wine, which has now been undergoing the operation for six years in common quart bottles, shows a diminution of about three ounces in each bottle. The specific gravity of the residue is augmented, and the increased quantity of acid and spirit bears a very exact relation to the quantity of water that has disappeared. Upon comparing this wine with some of the same vintage which had remained in corked bottles, its flavour and aroma had become so much more mellow and fragrant, that I had some difficulty in persuading myself of the original similarity of the two samples," p. 325.

In the Appendix to this work, Mr. Henderson has given very interesting details respecting wines, both of a chemical and a commercial nature, which could not have been introduced into the body of the work. One of these articles, on the quantity of spirits contained in different wines, is too interesting to be withheld from our readers. Mr. Brande had published long ago, a table of the quantities of alcohol contained in different wines; but though his experiments were, as might have been expected, accurate, some wines, that of Lissa in particular, seem to have been given to him under wrong names. Mr. Henderson has, therefore, made a selection from Mr. Brande's tables, and added the results of the experiments of Mr. Ziz, an able chemist of Mentz, and many original ones which that eminent chemist Dr. Prout undertook at his request. Dr. Prout introduced a known quantity of wine into a retort, furnished with a receiver, into the tubulature of which was fixed a long slender glass tube of safety. The distillation was carried on very slowly till about two-thirds of the wine, and, consequently, the whole of its spirit, had passed into the receiver. The quality and specific gravity of the distilled fluid were then accurately ascertained, and the proportion of alcohol of sp. gr. 0.825 by bulk, was determined from Gilpin's tables. Mr. Zis used the tables of Lowitz, which fixes the standard of alcohol at 0.791. His results, therefore, when reduced to the British standard, would be greater than in the following table.

Table of the Quantity of Alcohol in Different Wines.

		Alcohol in 100 parts by measure.
French Wines.		
Champagne (average of four kinds)		12.61 Brande.
Burgundy (average of four samples)		14.57 Br.
Do. 20 years in bottle		12.16 Prout.
Red Hermitage		12.32 Br.
Frontignan		12.79 Br.
Cote Rotie		12.32 Br.
Claret		12.91 Br.
Sauterne		14.22 Br.
Grenache		21.24 Pr.
Spanish Wines.		
Sherry, very old		23.80 Pr.
Do. average of four specimens		19.17 Br.
Alba Flora		17.26 Br.
Malaga, 1666*		18.94 Br.
Do.		17.26 Br.
Portuguese Wines.		
Port (average of seven specimens)		22.96 Br.
Do.		20.64 Pr.
Do. (Vinho de Ramo)		15.62 Pr.
Collares		19.75 Br.
Lisbon		18.94 Br.
Carcavellos (average of 21 specimens)		18.65 Br.
Bucellas		18.49 Br.
German Wines.		
Johannisberger,	1788	8.71 Pr.
Rudesheimer,	1811	10.72 Pr.
Do.	1800	12.22 Ziz.
Oestricher,	1801	8.46 Ziz.
Zornheimer,	1804	8.75 Ziz.
Do.	1802	10.16 Ziz.
Do.	1803	9.00 Ziz.
Oestricher,	1804	10.66 Ziz.
Do.	1802	10.50 Ziz.
Bodenheimer,	1802	13.96 Ziz.
Rhenish, submitted to Soemmering's process for four years		7.58 Pr.
Same wine, in its natural state		7.36 Pr.
Rhenish, submitted to Soemmering's process for 3½ years		7.00 Pr.
Hungarian Wine.		
Tokay		9.88 Br.
Italian and Sicilian Wines.		
Aleatico		16.20 Pr.
Ætna or Syracuse		30.00 Pr.
Syracuse		15.28 Br.
Marsala 21 years old, submitted to Soemmering's process for five years		18.40 Pr.
Lissa		15.90 Pr.
Wines of Madeira and Canary Isles.		
Madeira (average of four specimens)		22.27
Madeira (West India)		21.20
Malmsey, Madeira		16.40
Teneriffe		19.79
Cape Wines.		
Constantia		14.50 Pr.
Stein wine		10.60 Pr.
Persian Wines.		
Shiraz, white		19.80 Pr.
Do. (Red ?)		15.52 Br.

The results in the two following tables were obtained by Dr. Prout.

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* This wine was buried in the fire of London, and dug up about twelve years ago.

Specific Gravities of Wines.

Grenada		1.053	Rhenish, submitted to Soemmering's process four years	0.9997
Port		0.9890	Same wine, in its natural state	0.9992
Johannisberger		0.9978	Rhenish submitted to Soemmering's process 3½ years	0 9968
Rudesheimer		0.9937	Aleatico	1.0200
Oestricher,	1801	0.9960	Ætna or Syracuse	0.9911
Zornheimer,	1804	1.0310	Lissa	0.9913
Do.	1802	0.9790	Madeira	0.9988
Do.	1803	0.9960	Constantia	1.8810
Oestricher,	1804	0.9920	Shiraz	0.9944
Do.	1802	0.9890		
Bodenheimer		0.9890		

Quantity of Acid in 100 *parts of Different Wines, equal to Crystallized Tartaric Acid by Weight.*

Johannisberger,	1786	9.38	Same wine, in its natural state	10.05
Rudesheimer,	1811	6.22	Rhenish, submitted to Soemmering's process 3½ years	8.4
Rhenish, submitted to Soemmering's process, four years		10 58		

We regret that our limits will not permit us to give more than the decennial average of the quantity of wine imported into Britain, from 1697 to 1822 inclusive.

Imported into England.		Imported into England.		
1697 to 1706 inclusive	15,622 Tuns.	From 1785 to 1795		25,855 Tuns.
1706 to 1716	15,999	1795	1805	29,090
1716 to 1726	22,602	Nine years average.*	to 1815	37,830
1726 to 1736	23,109	Eight years average.	to 1823	26,212
1736 to 1746	17,631			
1746 to 1756	15,784			
1756 to 1766	16,255			
1766 to 1776	17,212			
1766 to 1785 9 years	14,873			

We cannot conclude this analysis without recommending to our readers the perusal of Mr. Henderson's work. The information which it contains is highly interesting, and the whole is drawn up with elegance as well as with judgment. The vignettes and embellishments of the work are remarkably beautiful.

V. *Monographie du Genre Hirudo, ou Description des Espèces de Sangsues,* &c.

Monograph of the Genus Hirudo, or a Description of the Species of Leeches which are found or are used in Piedmont, with Observations on their mode of Generation, and on other points connected with the Natural History of some of these Species. By PROFESSOR H. CARENA; *with Figures Drawn and Coloured after Nature. From the Memorie della Reale Accademia della Scienze di Torino,* tom. xxv. p. 273—317.

PROFESSOR CARENA introduces his well-written memoir, by describing the steps he took to verify the species, on the anatomy and physiology of which he proposed writing. To this very important point, (and which we would most particularly recommend to all anatomists,) he was urged by discovering that the leech in common use at Turin for the purposes of phlebotomy, had been described neither by Linné nor by subsequent writers. M. Carena proceeded therefore to examine and determine the various species found in the lakes and marshes of Piedmont; and he quickly discovered that the medicinal leech employed at Turin was not a native of the waters of Piedmont, but of French origin, and imported from Toulon and Marseilles.

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* The records of 1813 were destroyed by fire.

M. Carena next proves, what indeed we should expect, that this use of foreign leeches was limited nearly to Turin, whilst in the valley of "Suré," in the "Cenevais," and in the duchy of Aosta, the inhabitants employ their native leeches, all of which, with some very trifling differences, he found to correspond with that of the north, described by Linné and by Müller. He rejects the term medicinal (used specifically) as not characterizing any particular species, (and in so doing we suppose him quite correct,) and considers as distinct species, many which have hitherto been deemed mere varieties. The determination of this and other points in the natural history of the animal, will fall rather to be considered by those engaged in the compilation of systematic works.

It arises, we suppose, from a respect for the names of Linné and Müller, that Professor Carena still retains the name of "Medicinal" in characterizing the first species he describes. He has divided the genus Hirudo into ten distinct species, as follows: 1. Hirudo Medicinalis (Lin.) 2. H. Provincialis (Mihi.) 3. H. Verbana (Mihi.) 4. H. Sanguisuga (Linn.) 5. H. Vulgaris (Müll.) Octoculata (Linn.) 6. H. Atomaria (Mihi.) 7. H. Complanata (Linn.) 8. H. Cephalota (Mihi.) 9. H. Bioculata (Müll.) 10. H. Trioculata (Mihi.) To every one of these species, M. Carena has annexed a very good description of their natural habits, where found, &c. with occasional critical remarks. On the subject of the eyes of the leech, for example, he observes that, as it may still be doubted whether the dark points placed around the anterior disk of the leech really serve for vision or not, he has preferred designating them by the name of *ocular points* (points oculaires.) A leech may be often seen to elongate itself, and suddenly withdraw its anterior extremity, *on coming in contact with any body;* and an individual leech, deprived of the anterior segments, including those supposed visual organs, was observed to be regulated in all its movements, precisely as other perfect ones. Professor Carena conjectures that they may be of use to the animal only in obscure situations. We would venture to suggest another opinion on this subject, which is, that the eyes of the leech may be merely adapted for the perception of light, and to regulate its movements; accordingly, leeches generally shun the light. There would seem to prevail a great error in supposing that, in all animals which possess eyes, the faculties of these organs must resemble the human eye, or speaking more generally the eyes of the higher orders of vertebral animals. Yet experience, as far as it goes, proves that the mole, and many molluscous animals, form no distinct perception of objects, though they are directed by the visual organs they possess to seek or shun the light, as circumstances may require. We feel inclined, from a variety of considerations, to think that the ocular points of the leech are really eyes, such as exist in some of the invertebrate animals.

Certain differences are described as existing in the teeth of the Hirudo Sanguisuga, whose ordinary food is stated to be, the common earth worm, which it breaks into convenient pieces, and swallows. The Hirudo Vulgaris is oviparous; the process of reproduction is very minutely described by M. Carena. The young quitted the eggs, or general envelope, on the 21st day; the number of germs in any egg was never more than twelve, nor less than nine; but then it always happened that one or two of them proved abortions.

There are circumstances in the history of the Hirudo Complanata which may possibly determine the naturalist at some future period to remove this animal entirely from the genus Hirudo. It rarely moves; never swims, and its ordinary dimensions present the maximum of contraction of which its body is capable. The Hirudo Cephalota, which is viviparous, is, in the same circumstances as to arrangement with the Complanata. The Trioculata, described as a very rare leech, does not swim.

On the subject of the locomotion of the leech, M. Carena thinks that the terminating disks of this animal adhere to the substance on which it creeps, by the simple adhesion of surfaces, and not by any real suction. He remarks that the animal still adheres to the surface on which it is placed, even though a portion of the disk has been forcibly detached; an experiment which, if correct, entirely overthrows the usually received notion of any vacuum having been formed. We confess we are still inclined to adhere to the old opinion.

Of the experiments on mutilated leeches, alluded to by Professor Carena, one only has been detailed minutely. The leech was of the species he has called Provincialis, and was cut transversely into three portions, in the last week of February 1820. The middle portion alone was preserved in water renewed daily. This fragment was composed of 40 segments, and excluded the sexual openings. The wounds cicatrized in a few days, leaving in the centre an opening, which was the section of the alimentary canal.

This fragment proved very tenacious of life. It moved frequently about the porcelain dish in which it was placed, advancing always the extremity which corresponded to the head. It frequently changed its epidermis, and excrements issued from time to time through the posterior extremity. These appearances continued to present themselves until the middle of July, when the author, having occasion to quit home, with the view of completing this very Monograph, of which we now render an account, entrusted the fragment to one of his colleagues, Professor Rossi, with whom it was still alive on the 10th December 1820, *i. e.* about ten months after the date of the experiment.

ART. XXIX.—NOTICES OF RECENTLY PUBLISHED BOTANICAL WORKS.

GREAT BRITAIN.

It was our intention here to notice particularly the contents, and to offer some remarks upon those which appeared the most important, of the following publications. The number, however, of these articles, and the degree of space which is already occupied by other botanical subjects, effectually prevent our doing this so fully as we had anticipated; and we must reserve to ourselves the agreeable task of investigating these works in a future number, and confine ourselves, at present, to giving little more than a list of their titles.

Systematic Botany.

Under this head we have peculiar satisfaction in announcing the long expected account of the Botany of Melville Island, by Robert Brown, Esq. which forms one portion of the Appendix to Captain Parry's First Voyage, under the title of a *List of Plants collected in Melville Island, by the Officers of the Expedition, with Characters and Descriptions of the new Species.* We find, in this production, the same acute research, combined with that wonderful correctness of observation, that characterise all this gentleman's writings: and although from several causes, of which an ill state of health was the principal, Mr. Brown did not extend this Memoir, especially, as he had intended, to what concerns the *comparison* between the state and relative proportions of the primary divisions and natural orders contained in this list, and a parallel between the vegetation of regions in nearly similar climates and latitudes; yet the botanical world, highly as its expectations have been raised with respect to this publication, will feel no disappointment in investigating its contents. The number of species amounts to 116.

Smith's English Flora.

THE British botanist will have great pleasure in hailing the appearance of the first two volumes of the *English Flora,* by Sir James E. Smith, President of the Linnæan Society, &c. &c.; a work which, as might be expected from the hand of such a master, will unquestionably hold a first rank among publications of the kind. Notwithstanding all that had been done among the vegetables of the British Isles, by the same learned author, in his two works, the *English Botany,* and *Flora Britannica,* so many, as he himself states, have been subsequently discovered, and so many alterations and improvements have taken place in the science, that he found it necessary to commence the present undertaking as an entirely new work; a character to which the book itself amply justifies its pretensions.

The whole is written, as may be inferred from its title, in the English language, and is arranged according to the system of Linnæus; the two volumes including the first twelve classes, from Monandria to the end of Icosandria. The remaining volumes are anxiously expected.

Dr. Greville's Flora Edinensis.

ANOTHER work, that peculiarly claims the attention of those who are interested in the botany of Scotland, is the *Flora Edinensis*, or a "Description of Plants growing near Edinburgh, arranged according to the Linnæan System, by R. K. Greville, LL.D. F.R.S. Edinburgh," &c. With a degree of perseverance that does him high credit, this author has most successfully explored the botanical productions of the environs of that romantic city, as is evident from the great number of species that he has accumulated within a radius of ten miles from the town, whether growing in the fields, upon the hills, among the woods, or on the sea shore. The particular stations are very fully stated, together with generic and specific characters, and remarks; and the whole is arranged with great correctness, according to the artificial classes and orders, although each genus is headed by the name of the natural order to which it is referred, according to the most approved method.

But what will render this book valuable, not only to the botanists of Scotland, but to all who desire to be acquainted with the vegetable productions of the British kingdom, is the great attention which Dr. Greville has devoted to the class Cryptogamia, and particularly to the Fungi. Considered in this light, the *Flora Edinensis* is the first work in which the Fungi of any portion of this country have been arranged with much precision, as to what concerns their families and genera. Dr. Greville has taken advantage of what has been effected by all the recent continental writers on the subject, and has introduced many new and valuable improvements. References, too, are of course given to the figures in the author's *Scottish Cryptogamic Flora*, where a great many new genera, as well as new species, are admirably represented, accompanied by such dissections as render them of the highest importance to the student of this difficult but interesting family of plants.

Mr. Roscoe's Monandrian Plants, of the order Scitamineæ.

IT is well known that Mr. Roscoe, who has made so many and so great improvements in what concerns our knowledge of the plants of the natural order *Scitamineæ*, has long been meditating a splendid work, with figures of this highly curious and beautiful family. The first number of this publication has recently appeared, bearing the title *Monandrian Plants of the order Scitamineæ; chiefly drawn and coloured from* living *specimens in the Botanic Garden at Liverpool, and other conservatories; arranged according to the System of Linnæus, with descriptions and observations, by William Roscoe, Esq. Associate of the First Class of the Royal Society of Literature,"* &c. &c.

If we consider the peculiar utility of this tribe of plants, many of them producing valuable spices, medicines, and dyes, as the *Zedoary*, the *Cassumanar*, the *Cardamom*, *Ginger*, *Arrowroot*, &c. as well as the delicate beauty of their blossoms and their foliage, we must allow that the venerable historian of the Medici could not have selected a subject more worthy to be illustrated by his taste and judgment throughout the whole range of botanical beauty and interest. The garden, too, of Liverpool, which owes so much to this gentleman, has, under his patronage and advice, seconded by the judicious direction of its curators, Messrs. J. & H. Shepherd, become possessed of such treasures in Scitamineous plants, received from Africa and from both the Indies, as no other collection in the world can equal. Possessed of these advantages, Mr. Roscoe commences the present undertaking: and most sincerely do we wish him health to complete his labours, the result of which will redound as much to his own credit, as it will to the advantage of science. The whole work will be comprised in eight numbers.

No. 1. contains one *Canna, C. flaccida* of Salisbury and Redouté; one species of *Phrynium, P. parviflorum* of Roxburgh's Fl. Indica; two *Hedychia, H. glaucum,* Roscoe, (allied to *H. gracile* of Fl. Indica,) and *H. longifolium,* (allied to *H. carneum* of Loddiges;) two *Alpiniæ, A. calcarata* of Roxburgh, and *A. mutica* of Roxb.; *Zinziber officinale,* the Ginger of the shops, which but very rarely produces its flowers; and lastly, *Kæmpferia marginata* of Dr. Carey's MS.

The descriptions and remarks are entirely in English. The plates are executed in lithography, and coloured under the superintendence of Mr. Graves; and the whole is upon an imperial folio size, the plates and descriptions being contained in a portfolio.

Some account of the periodical Botanical works, as Sims' *Botanical Magazine,* the *Botanical Register,* Loddiges' *Botanical Cabinet,* and Hooker's *Exotic Flora,* will be given in our next Number.

CONTINENTAL BOTANICAL WORKS.

New Deutschland's Flora.

At the same period that the learned President of the Linnæan Society is engaged in editing the Flora of our native country, in our native tongue, Professor Mertens and Dr. Koch of Bremen are similarly employed in compiling a Flora of Germany, in the language of that empire, entitled, "*Deutschland's Flora,*" which, from the well-known celebrity of its authors, will, it may safely be argued, far exceed in importance every other publication on the subject that has yet appeared in that country.

Of this likewise two volumes have appeared; but the first is occupied with an excellent dictionary of botanical terms. The second begins the descriptive part; and so fully and minutely have the authors described the genera and species, that although the volume contains nearly 900 pages, it comprises no more than to the end of the 4th class.

We cannot help noticing the typography of this work, as far excelling that which we have ever seen employed in publications of this kind, proceeding from the German press; and the paper likewise, (we speak, however, from a presentation copy,) cannot be surpassed, either for quality or colour.

De Candolle's Prodromus Systematis Naturalis Regni Vegetabilis.

One of the greatest desiderata among botanists has hitherto been an *Universal Flora*, arranged according to the Natural Orders; and if we were asked to point out the individual who was best fitted for such an undertaking, both by his vast knowledge and his great activity, we should unquestionably have fixed upon the eminent name which stands at the head of this article. Professor De Candolle commenced this important task, as is well known, with the *Regni Vegetabilis Systema Naturale, sive Ordines, Genera et Species Plantarum, secundum methodi naturalis normas digestarum et descriptarum,* which extended to two volumes, each comprising between 600 and 700 pages, yet containing only the first eleven orders of M. De Candolle's arrangement, the last of them being the Cruciferæ, or about 2000 species.

Upon such a plan, including, as the Flora of the world now does, upwards of 50,000 known species, the work would have extended to a very great number of volumes, and have occupied the greater portion of the life of the esteemed author. Under this impression, Professor De Candolle was induced to alter his plan; and, before proceeding with the large work, to edite with all the dispatch possible, consistently with the nature of such an undertaking, a *Prodromus Systematis Naturalis Regni Vegetabilis, sive Enumeratio contracta Ordinum, Generum Specierumque Plantarum hic usque cognitarum juxta methodi naturalis normas digesta;* in which it is expected that all the known plants may be included in four very closely printed 8vo. volumes. Of this publication the first volume has appeared, containing the first 54 orders of De Candolle's sub-class *Thalamifloræ,* and above 6000 species. The department, which has cost the author the greatest labour, and on which he justly sets the highest value, is the *natural arrangement in the genera,* a subject which has been hitherto almost wholly neglected. This is effected, in most instances, by the division of the genera into sub-genera, or natural sections, to which are affixed proper names and characters taken from the fructification, (as in the case of actual genera,) but which do not alter the known appellations of the species. By means of this method, originally adopted in Zoology, the necessity of constituting new genera, and altering old established names, is avoided, and all the utility of order in classification is preserved. The whole is very closely printed upon 750 pages, and is published at Paris.

We may here mention, that Dr. Hooker, Professor of Botany in the University of Glasgow, is at this time engaged in preparing an *Universal Flora,* in the English language, in which he will follow entirely the arrangement, and, in many instances, the generic and specific characters, which have been adopted by De Candolle in his Prodromus. Every new species to which Dr. Hooker can obtain access, will besides be added, and the work will be accompanied with plates, drawn by himself, illustrative of the natural orders. The first part will appear at the commencement of the ensuing year.

Professor De Candolle has been likewise employed in the publication of three important memoirs, which he has obligingly presented to us,

1. On some new genera of the family of *Buttneriaceæ.*

2. On the family of *Ternstræmiaceæ.*

3. On the new or rare plants which have flowered in the Botanic Garden of Geneva during the years 1819, 1820, and 1821.

By a letter which has just reached us from Professor De Candolle, we are informed that he is at this moment deeply engaged on the natural family of *Leguminosæ,* in which he finds much to interest him, as well as many alterations to be made. The result of these investigations he will, before the end of the year, lay before the public, either in the second volume of his Prodromus, or in some memoirs published in Paris.

Martius, Genera et Species Palmarum Brasiliensium ; and *Nova Genera et Species Plantarum Brasiliæ.*

The expedition of Drs. Spix and Martius into Brazil, by the order and at the expense of his Majesty Maximilian Joseph I. King of Bavaria, besides having given origin to the interesting travels just written by these gentlemen, and other works connected with science, has laid the foundation for two works on the plants of that country, which, as far as we can judge by what is already published of them, bid fair to equal, if not surpass, any thing of the kind ever executed in Germany; and deserve to be placed on a level with the splendid productions of Humboldt, Bonpland, and Kunth, which have appeared in Paris.

We have received one Fasciculus of the Palms, and two of the Nova Genera. The first is entitled *Genera et Species Palmarum quas in itinere per Brasiliam, annis* 1817–1820, *jussu et auspiciis Maximiliani Josephi I. Bavariæ Regis Augustissimi suscepto, collegit, descripsit, et iconibus illustravit Dr. C. F. P. Martius, Ordinis Regii Coronæ Bavaricæ Eques,* &c. &c. 1823. The size is an atlas folio, the only one, indeed, suited to the magnificence of the subjects; and the plates are executed in lithography, in a manner that cannot probably be equalled elsewhere; for it is well known that at Munich this art has arrived to a very high degree of perfection. Some sets are coloured, others plain. The first fasciculus contains, besides 28 pages of letter-press, 25 species of Palms; the greater number of which are entirely new, and belonging to genera which are here first established. We are not informed to what number of species the work will be likely to extend.

The *Nova Genera et Species Plantarum quas in itinere per Brasiliam,* &c. merits very high praise. Each of the two fasciculi that have reached us contains 18 or 20 pages of letter-press, and 12 lithographic plates, extremely well coloured.

Letters on the Highlands of Scotland, addressed to Sir Walter Scott, Bart. In four volumes octavo.

The appearance of this work, which is on the eve of publication, has been looked forward to with high expectation by those who take an interest in the Highlands of Scotland; and when we inform our readers that it is from the pen of Dr. MacCulloch, we are confident that they will agree with us in thinking, that their expectations will not be disappointed.

Having had occasion for many years, both as a private individual, and as mineralogist to the Ordnance Survey, to examine every part of Scotland with the minutest attention, he has collected a body of materials as curious as they are important. The results of his scientific labours have been partly published in the *Geological Transactions*, and in his work on the Western Islands, and his geological researches will be found in a still more interesting form in his mineralogical map of Scotland, which, we trust, the liberality of government will soon enable him to complete; but he has reserved for the present work all those general topics connected with the history, the antiquities, the literature, the picturesque scenery, and the statistics of the Highlands, which have derived a new interest even among foreign nations, from those splendid works of fancy which are still adorning the literature of Scotland.

To this interesting task few men could bring such varied talents as Dr. MacCulloch. A profound chemist; an excellent natural philosopher; deeply versed in mineralogy, geology, and every other department of natural history, he was able to discover and explain those interesting phenomena of the natural world which our land of rocks and floods so often presents to the philosophic eye; and which had been almost entirely neglected, either from the incapacity or the indolence of those who ought to have examined them. To these indispensible qualifications Dr. MacCulloch added those of an antiquarian, a political economist, and a skilful draftsman; and from his intimate habits of intercourse with our first nobility, and his continual sojournings among the population of our coasts and valleys, he enjoyed opportunities which no other man ever possessed of studying the manners and customs of the Highlanders, as well as their political, agricultural, and moral condition.

The results of these various and popular inquiries will be found in this work under the following heads:

A general description of all the country within the Highland border, and of each of the islands which belong to that division of Scotland.

A description of the various picturesque scenery occurring in the mainland and in the islands.

A description of the various antiquities of the Highlands.

A historical sketch of the Highlands, from the earliest records.

Investigations respecting the ancient state of policy, clanship, manners, and usages, among the Highlanders.

Inquiries respecting their language, poetry, music, and dress, &c.

Inquiries into the agriculture, the manufactures, the fisheries, the tenures of land, and the present condition of the population; with suggestions respecting eventual improvements, and

Miscellaneous notices on the natural history of the country.

Art. XXX.—PROCEEDINGS OF SOCIETIES.

1. *Proceedings of the Royal Society of Edinburgh,* 1824.

April 5th, 1824.—A paper by Dr. Edward Turner was read, entitled, "On the Application of Professor Dobereiner's Discovery to Eudiometry."

On the same evening a paper by George Anderson, Esq. was read, "On the Quartz District in the Neighbourhood of Loch Ness."

April 19th.—A paper by Dr. Brewster was read, "On the Optical and Mechanical Structure of the Minerals which form the Composite System, which it is proposed to add to the other Systems of Crystallography."

Professor Mohs having arranged minerals under four systems, viz.

1. The Rhomboidal System.	3. The Prismatic System.
2. The Pyramidal System.	4. The Tessular System.

The author of this paper proposes to add the *Composite System,* as marking, by a simple and unequivocal name, the general character of the structures of the minerals which it comprehends.

The Composite minerals divide themselves into two classes, viz.

Class I. Those in which the physical properties of the individual crystals are *not altered by the combination;* and

Class II. Those in which the physical properties of the individual crystals *are altered by the combination.*

Both classes are subdivided into two orders: I. Those crystals which are found separately in nature; and II. Those which are not found separately in nature; and these are again subdivided into Sections.

As most of the structures described in this paper are entirely new, and require to be illustrated by figures, we are not able at present to give any further account of them.

May 3d.—The following gentlemen were elected ordinary members of the Society:

William Wood, Esq. President of the Royal College of Surgeons.
Dr. William Crosbie Mair, Physician to the Embassy to Mexico.

Dr. Turner's paper was concluded at this meeting.

May 17th.—A paper by Dr. Brewster was read, entitled "A Description of two filamentous Surfaces of Quartz incapable of reflecting Light." This paper is printed in the present Number, p. 108.

There was laid before the Society a Memoir, by Professor Moll of Utrecht, and M. Von Beek, on the Velocity of Sound.

2. *Proceedings of the Wernerian Natural History Society.*

March 19th, 1824.—There was read at this meeting an account of a new British species of Spatagus, and also of a new species of Plumularia, brought home by Captain Parry, by the Rev. Dr. Fleming, of Flisk.—Observations, by P. J. Selby, Esq. were also read, on the natural history of the Golden-Crested Regulus, and notices on the management of young plantations, by Mr. F. C. Parry.

April 8.—Dr. Knox read his remarks on the supposed discoveries of Professor Tiedemann, on the distribution of the lacteal vessels in the *Phoca vitulina, &c.*

These remarks on a very interesting physiological point will be given in an early Number. In the mean time, we may refer our medical readers for some account of them to the *Edinburgh Medical and Surgical Journal* for July.

April 17.—A paper by Dr. Knox was read, in which he gave an account of his discovery of the presence of a dark-coloured *periosteum*, investing nearly all the bones of the *Colymbus septentrionalis.* This singular appearance has been observed in very few birds, and these have belonged to genera very distinct from the Colymbus. The paper will be published in a succeeding number of this Journal.

A colossal species of sponge was exhibited, said to be from the Indian sea. We did not remark that any description was given of this sponge, which may or may not be a particular species. There were even doubts raised, (after the meeting of the Society had closed,) whether the substance in question was really a sponge or not. As no opportunity occurred to us of examining it carefully, we shall not venture to offer any opinion on the subject. It seemed to us a sponge, and of a form not unlike what we had occasionally seen. In the very philosophic work of Grew, on *The Anatomy of Guts and Stomachs*, there is a drawing much resembling this colossal sponge.

April 28th.—A memoir on the Sand Hills in the vicinity of Edinburgh was read.

A specimen of the native dog of New Holland, and another of a dog from Greenland, were exhibited to the Society.

May 12th.—A paper by Henry Witham, Esq. was read, On the Peculiarities in the Trap Rocks in the Counties of York, Durham, Westmoreland, and Northumberland; also a notice by Robert Stevenson, Esq. on the pernicious effects on Fruit Trees, of thin layers of Bog Iron Ore immediately under the surface soil in Aberdeenshire. Mr. Deuchar likewise read a notice on the Theories of Galvanism.

3. *Proceedings of the Cambridge Philosophical Society,* 1824.

March 1st.—J. Okes, Esq. honorary member of the Cambridge Philosophical Society, read a notice of a considerable number of fossil bones of the Elephant, Rhinoceros, Buffalo, Deer, Horse, &c. found near Bamwell, Cambridgeshire, in a sandy gravel, intermixed with bleached specimens of several species of land and fresh water shells, indigenous to Cambridgeshire.

Rev. W. Mandell, B.D. Queen's College, read an unedited letter of Sir I. Newton to Mr. Aclaw of Geneva.

Rev. Professor Sedgwick, M.A. Trinity, read a communication containing some additional observations on the geology of Teesdale, made during the year 1823.

March 15th.—Rev. W. Mandell, B.D. Queen's College, gave a description of a self-regulating lamp.

G. B. Airy, B. A. Trinity, read a communication on the figure of equilibrium of a fluid disturbed by small forces. The form assumed by the fluid was found, from an investigation on simple principles, conducted with reference in particular to the figure of Saturn as affected by the action of his ring; and it was shown, that the peculiarity of Saturn's form observed by Sir W. Herschel cannot arise from this attraction.

Professor Sedgwick continued the reading of his supplemental observations on the geology of Teesdale.

March 29th, Rev. W. Mandell, B. D. Queen's College, exhibited a mode of defending locks from the insertion of skeleton keys.

A communication was read from G. Harvey, Esq. F.R.S.E. M.G.S. &c. "On the Fogs of the Polar Seas."

Mr. Harvey, assuming the principle laid down by Dr. Hutton, "that the production of fog or mist arises from the admixture of volumes of air of unequal temperature, and holding water in solution," explains the prevalence of dense fogs in the Arctic seas during the summer months, by supposing that the air which surrounds the different icebergs is kept at a lower degree of temperature than the air which reposes upon those portions of the ocean that are free from ice. Whenever, therefore, this cooler air intermixes with the warmer, fog will be the result, varying in density according to the modifying causes which may chance to operate.

Professor Sedgwick concluded his supplemental observations on the geology of Teesdale.

Art. XXXI.—SCIENTIFIC INTELLIGENCE.

I. NATURAL PHILOSOPHY.

ASTRONOMY.

1. *Mr. Herschel and Mr. South, on Double Stars.*—By means of Mr. South's superb equatorial instruments, Mr. Herschel began, in 1821, a re-measurement of the angles of position and distances of the double stars discovered by the late Sir W. Herschel and others. The determination of the distances and positions of about 350 of these interesting objects, being the results of 10,000 individual measures, have been recently communicated to the Royal Society.

2. *Singular Differences in Astronomical Observations.*—It is a very remarkable fact, that different astronomers observe differently with the same instruments, so that the differences have a constant character. The following table shows the differences between the observations of some of the most eminent astronomers of the present day.

Bessel and Walbeck,	— 1″.041	Bessel and Struve, in 1814,	— 0″.044
Bessel and Argelander,	— 1 .223	—————— 1820,	— 0 .680
Struve and Walbeck,	— 0 .[illegible]	—————— 1821,	— 0 .799
Struve and Argelander,	— 0 .202	—————— 1823,	— 1 .021

M. Bessel is disposed to think that these differences may arise partly from the way in which each astronomer counts the time by his ear, while he is watching the motion of the star with his eye.

3. *On Different Circular Micrometers.*—This instrument, which has now come into general use in some of the principal observatories in Europe, was, so far as we can learn, first proposed by Dr. Brewster, and used by him for viewing terrestrial angles, as well as small arches in the heavens. One of these micrometers, made of mother-of-pearl, was constructed for him by Mr. Adie, in 1810 or 1811, and has been described in his treatise on *New Philosophical Instruments,* Edinb. 1813, p. 48. In this instrument, which had its circumference divided into 360°; the semi-transparency of the mother-of-pearl ring indicated the approach of the star to the inner circle.

In Frauenhofer's *suspended* circular micrometer, which is so called from its appearing to be suspended in the field of vision, a narrow steel ring is fixed on a plate of glass about 1 inch in diameter, having a circular hole cut in its centre greater than the inner diameter of the steel, which is accurately turned. The outer circumference of the steel ring is also turned accurately, so that the immersions and emersions of the heavenly bodies at both circumferences of the steel ring may be observed, and the differences of Right ascension, and declination of the stars accurately calculated, by appropriate formulæ.

Another micrometer, consisting of two sets of parallel lines, engraven upon glass, and the one set crossing the other at known acute angles, has been recommended by Frauenhofer for determining the relative place of two *very near* stars, such as those which compose a double one. See page 104.

4. *Mr. Adams's Nautical Eye Tube.*—Although we are acquainted with the principles and construction of this ingenious substitute for an artificial horizon, which we owe to Mr. M. Adams, Rector of the Academy at Inverness; yet, as he has not made it public, we do not mean to give any description of it. As the invention, however, has been noticed in the *Quarterly Journal,* we may mention that it has been submitted to the Board of Longitude, and that several of the instruments have been sent out to be tried by experienced naval officers. Lord Napier, with his usual zeal to promote the interests of science, intends to make particular trials of the eye tube on board the Diamond. What the result may be in the hands of others cannot be foreseen; but we have examined the results obtained by Mr. Adams on board the Clio, and the agreement of them with contemporaneous observations made by Captain Strangways, is truly surprising. There is no doubt, indeed, that Mr. Adams himself has acquired the art of using his eye tube with wonderful dexterity; and therefore the same dexterity may be expected after a little experience from our naval officers.

5. *Observations on the Occultation of Jupiter on the 6th April.*—Mr. James Veitch observed this occultation at Inchbonny, near Jedburgh. See page 194.

	Mean Time.
Immersion of 4th Satellite,	11h 6' 45"
Immersion of 3d Satellite,	11 10
Immersion of Jupiter,	11 18
Immersion of 2d Satellite,	11 22 20
Immersion of Jupiter,	12 10 30
A fixed star was eclipsed by the moon at	11 18 0

6. *Elements of the Comet of* 1824.—

Passage of perihelion, at Greenwich, 1823, Dec.	9.3677	Taylor.
	9.4792	Carlini.
	9.4521	Richardson.
Longitude of node,	302° 56' 34"	Taylor.
	303 4 4	Carlini.
	303 1 43	Richardson.
Longitude of perihelion,	28 43 54	Taylor.
	28 26 8	Carlini.
	28 20 6	Richardson.
Logarithm of nearest distance,	9.3598242	Taylor.
	9.3545000	Carlini.
	9.3536855	Richardson.
Inclination of orbit,	75° 55' 45"	Taylor.
	76 12 50	Carlini.
Motion retrograde,	76 8 28	Richardson.

Quarterly Journal, No. 33.

7. *Return of Encke's Periodical Comet.*—Professor Encke has given in Bode's *Alm.* 1826, p. 124, the following places of this singular body, which it is expected will be visible in Europe in August 1825.

	D.	R. Asc.	N. Decl.
1825. Aug.	1.6	82° 31'	32° 1'
	6.6	90 23	32 9
	11.6	99 1	31 44
	16.6	108 19	30 36
1825. Aug.	21.6	118° 9'	28° 37'
	26.6	128 14	25 40
	31.6	138 23	21 46

OPTICS.

8. *Singular Effect of Heat on the Colours of Glass.*—In a memoir on rare minerals, published in the *Memoirs of the Physical Society of Geneva*, tom. i. part ii. p. 471, M. Soret mentions some curious facts respecting two kinds of glass employed by MM. Dumas and Raisin of Geneva, in giving the tints to artificial topazes.

One of these glasses or pastes is of a bright yellow colour, similar to that of the corundum commonly called *oriental topaz*. When this glass is reduced to small fragments, and exposed to the action of the fire, it assumes in succession the following colours, viz. *bright yellow, orange yellow, orange, orange red, violet red.*

Another paste, of an aqua-marine blue colour, or a *bright blue*, passes, by the application of an increasing heat, from *bright blue* to *bright aqua-marine green*, and then to yellowish-green. In cooling, the glass returns to its first tint through the same tints. If the fire is pushed to red heat, the *yellowish green* tint becomes a *bright yellow*, and finally an *orange yellow*. This last colour is permanent in the glass after cooling. M. Soret quotes the analogous experiments of Dr. Brewster on the Ruby, and those of M. Berzelius on different metallic glasses.

9. *Effect of Light on the Colour of the Sodalite from Greenland.*—Mr. Allan observed a very interesting phenomenon in relation to the action of light upon the colour of the sodalite of Greenland. When the massive variety is broken up, many portions of it have the most brilliant pink colour; but after a day's exposure to the action of light this brilliant pink colour almost entirely vanishes. Having broken a specimen into two, Mr. Allan kept one of them in the dark, and exposed the other to light. The specimen kept in the dark retained its pink colour unimpaired, while the other lost it almost entirely.

10. *Phosphorescence of Acetate of Lime.*—The following interesting observations on the phosphorescence of this salt were made by Mr. Nicholas Mill. He dissolved in water a quantity of acetate of lime, and placed it in a sand heat in a Wedgewood ware dish. He then evaporated it to dryness without disturbing it. When it was quite dry he placed the bulb of a thermometer on the bottom of the dish, and he found that at a temperature of 250° the lime adhered very firmly. He then excluded the light, and rubbing the acetate strongly with a stiff spatula, it became highly luminous.

11. *Effect of Heat on the Form and Double Refraction of Calcareous Spar.*—That active and eminent chemist M. Mitscherlich, observed, upon measuring the angles of calcareous spar at different temperatures, that there was a variation of 8′ 30″ in passing from 0° to 100° of the centigrade scale. The dihedral obtuse angle diminishes by heat, or the short axis of the rhomboid is more dilated than the other diagonals, so that its form approaches to that of a cube. Mitscherlich conjectured that its double refraction would also diminish by heat, and this was proved by M. Fresnel to be the case. The same effect, but in a lesser degree, was produced in rock crystal; but M. Fresnel observes that the experiment was not repeated. Hence it appears, that *heat uniformly distributed* in a crystal diminishes the double refraction. M. Mitscherlich is of opinion, that heat should always separate most the particles of a crystal in the direction in which they are nearest each other.

M. Fresnel likewise found, that heat dilates sulphate of lime less in the direction of its principal axis of double refraction (in the plane of the laminæ *) than in a direction perpendicular to it; a difference analogous to that in Iceland spar, but of a contrary character, as might have been expected, from the opposite nature of the double refraction of the two minerals. See *Bulletin des Sciences*, Dec. 1823, p. 181.

MAGNETISM.

12. *Mr. Barlow's Neutralizing Plate.*—We are happy to learn that this eminent natural philosopher has received the highest reward, viz. that of £500, given by the Board of Longitude, for his plate for neutralizing the action of the iron of ships in producing a deviation in the compass.

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* See *Edinburgh Encyclopædia*, Art. OPTICS, vol. xv. p. 588.

The centre of a small circular iron plate is placed in the line of the attraction of the ship's iron, and at a proper distance behind and below the pivot of the compass needle, the position of this line having been ascertained previously to the ship's leaving port, an operation which will be greatly facilitated by a table for this purpose, prepared by Mr. Barlow. When this is done, the needle will remain active and vigorous in the polar regions, and will direct itself in the true magnetic meridian, in whatever part of the world the ship is placed. This effect of Mr. Barlow's invention has been experimentally established between the 61° of south latitude and the 81° of north latitude, by the accurate observations of Lieutenant Foster, and by other naval officers. There are few scientific inventions of modern times more truly beautiful in principle, and more useful in practice, than this of Mr. Barlow's.

13. *Mr. Scoresby's New Experiments on Magnetism.*—Mr. Scoresby had formerly shown, that bars of steel could be rendered highly magnetic by hammering them in a vertical position, with the lower end resting upon a poker or rod of iron. This process, however, he has greatly improved by hammering the steel bars between two bars of iron. The steel bars were the eighth part of an inch in diameter.

When only one bar of iron was used, a steel wire, six inches long, lifted a nail weighing 186 grains; but when two bars of iron were used, the wire lifted 326 grains. When the new process was employed with an iron bar eight feet long, a steel wire six inches long lifted 669 grains, or four times its own weight.

Mr. Scoresby's theory of this process is, that percussion on magnetizable substances in mutual contact inclines them to an equality of condition, in the same manner as all bodies of different temperatures tend to assume the same temperature when in contact. The two great iron bars being made magnetical by position, the interposed bar of steel will therefore, when thrown into a state of vibration by percussion, receive a portion of their magnetism. In like manner a magnet, when struck in the air with a piece of flint, or upon a body of inferior magnetic quality, will have its magnetism diminished.

14. *Magnetic Variation near Littakun.*—Mr. Burchell found, by a very accurate observation made nearly in 24° 15′ of East Long. and 27° 20′ of South Lat. that the magnetic variation was 27° 7½′ West, a result which coincides nearly with that given in Hansteen's Chart and Tables. See Burchell's *Travels*, vol. ii. p. 325. Lond. 1824.

ELECTRICITY.

15. *Dr. Hare's Single Leaf Electrometer.*—This instrument is represented in Plate I. Fig. 10, which is an electrometer, with a single leaf suspended from a disc of zinc, six inches in diameter, which constitutes the top of the instrument Opposite to this single leaf is a ball, supported on a wire, which may be made to approach the leaf, or recede from it, by means of a screw. Above the instrument is seen a disc of copper, with a glass or metal handle. The electricity produced by the contact of copper and zinc is rendered sensible in the following manner. Place

the disc of copper on the disc of zinc, (which forms the canopy of the electrometer;) take the micrometer screw in one hand, touch the copper with the other, and then lift this disc from the zinc. As soon as the separation is effected, the gold leaf will strike the ball, usually, if the one be not more than $\frac{1}{100}$ of an inch apart from the other. Ten contacts of the same discs of copper and zinc will be found necessary to produce a sensible divergency in the leaves of the condensing electrometer. In the figure above referred to, AB is the copper disc, CD the zinc disc; *a* the gold leaf, *b* the ball, and *mn* the micrometer screw and scale for regulating and measuring the distance between the ball and leaf in hundredths of an inch, and HF the wooden stand to which the glass foot is secured.—Professor Silliman's *Journal*, vol. vii. No. ii. p. 351.

ELECTRO-MAGNETISM.

16. *Aurora Borealis imitated by an Electro-Magnetic Experiment.*—M. le Chevalier de Nobili, of Modena, the author of this experiment, took a large metallic wire, covered with silk, and coiled it up so as to form a spiral plate, with 24 turns, the wire of one turn being always in contact with the adjacent one. When a weak electrical discharge is made to pass through this spiral plate, a light is seen to proceed from the centre of all the spires. It resembles artificial fire, and is very distinctly visible without darkening the chamber in which the experiment is made. When the wire is coiled up in a rectangular shape, a very faint light is seen. M. Nobili considers this last as the ordinary electrical light, and the first as electro-magnetic, as it is displayed only in the case when electricity exerts a magnetic influence. M. Nobili has announced a work entitled *Questions sur Magnetisme,* in which he discusses all the recent discoveries in that science. See *Bibliothèque Universelle,* Jan. 1824, p. 39.

METEOROLOGY.

17. *Differences in Thermometers at low Temperatures.*—During the late arctic expeditions, Captain Parry found, by comparing ten thermometers, three of which contained mercury, and seven alcohol, that the difference of their indications was no less than 7½° lying between — 22½° and — 30. Two of these which indicated the mean of the whole were taken for use. At higher temperatures, the difference was found to be very inconsiderable.—*Captain Parry's Second Voyage,* p. 132.

II. CHEMISTRY.

18. *On the Combustion of Iron by Sulphurous Vapour.*—Professor Hare has observed, that if a gun barrel be heated red hot at the butt end, and a piece of sulphur thrown into it, a jet of ignited sulphurous vapour will issue from the touch-hole, when the mouth of the barrel is closed with a cork, or when it is blown into. He found that a branch of iron wire, exposed to this jet, will burn as if ignited in oxygen gas, and will fall down in the form of fused globules, in the state of protosulphuret. When hydrate of potash is exposed to the jet, it will fuse into a sulphuret of a fine red colour.—Dr. Hare's *Letter to Professor Silliman.*

19. *Dr. Hare's method of impregnating water with iron.*—If we place a few pieces of silver coin alternating with pieces of sheet iron in water, it will soon acquire a chalybeate taste, and a yellowish hue, and in twenty-four hours flakes of oxide of iron will appear. Hence if we replenish with water a vessel in which such a pile is placed, after each draught, we may have a competent substitute for a chalybeate spring.

Clean copper plates alternating with iron, or a clean copper wire entwined on an iron rod, would produce the same effect; but as the copper, when oxidated, yields an oxide, it is safer to employ silver.—Dr. Hare's *Letter to Professor Silliman.*

III. NATURAL HISTORY.

MINERALOGY.

20. *Hyalosiderite, a new mineral species.*—This mineral occurs chiefly in small crystals belonging to the prismatic system of Mohs, their form being in most cases that of a diprismatic combination, two opposite angles of which are truncated by a single plane, nearly like Fig. 30, Plate III. without the faces P. The inclination of *b* upon the adjacent face *b′* is =99° 22′, of *f* on *f′*=77° 50′, of *b* on *d*=130° 19′, of *f* on *d*=151° 5′. The edges between *b* and *b′* are sometimes replaced by a single face, or by the faces of another prism of 121° 0′. The surface of the crystal is smooth; but the crystals themselves are often imperfectly formed, and occur also in the shape of grains loosely coherent. Cleavage indistinct, parallel to *d*. Fracture small, conchoidal. Lustre vitreous, on the surface a metallic appearance. Colour reddish, or yellowish brown, with a brass-yellow or gold-yellow tarnish on the surface. Translucent on the edges, with a hyacinth-red, or wine-yellow colour. Streak of a cinnamon colour. Hardness =5.5 (between Apatite and Felspar.) Specific gravity =2.875.

Hyalosiderite was discovered by Dr. Walchner of Freiburg, in Breisgau, and recognised as a particular species by himself and by Professor Hausmann, of Gottingen. It occurs on the Kaiserstuhl, in Breisgau, near the village Sasbach, in a basaltic amygdaloid of a reddish-brown, or liver-brown colour, and is accompanied with augite and bitter-spar.

The crystals of Hyalosiderite become magnetic if gently heated to blackness. At a higher temperature they melt into a globule, which is attracted by the magnet. With borax they yield very readily a transparent glass coloured green by iron, varying in intensity according to the quantity of the mineral employed: it becomes black and opaque if the borax be saturated with it. With salt of phosphorus it leaves a skeleton of silica. The glass itself is greenish, and becomes colourless on cooling. With tin the glass of borax, containing a small portion of the mineral, becomes of a slight but beautiful green when cold.

Dr. Walchner gives a comparative chemical analysis, 1. Of hyalosiderite; 2. Of an iron slag from the Dax iron works in the Pyrénees, specific gravity =3.700; 3. Of an iron slag from Bodenhausen, in the Hartz, specific gravity =3.520; 4. Of a crystallized slag, from Lautenthal in the Hartz, described by Mr. Hausmann, specific gravity =3.870;

and 5. Of a mineral called volcanic iron-glass by Karsten. The last of these analyses is by Klaproth.

	1	2	3	4	5
Silica…………………	31.634	32.959	32.346	29.245	29.50
Protoxide of iron…..	29.711	61.235	62.042	63.316	66.00
Magnesia…………….	32.403	1.896	1.404	1.304	0.00
Alumina………………	2.211	1.560	0.000	1.244	4.00
Oxide of manganese	0.480	1.301	2.645	1.460	0.00
Potassa……………….	2.788	0.204	0.285	0.184	0.25
	Trace of Chrome.			Peroxide of copper 2.646	
	99.227	99.155	99.746	99.399	99.75

The iron slags appear, therefore, to consist principally of silicate of iron, part of the iron being replaced by magnesia in the hyalosiderite. Dr. Walchner moreover indicates an exact identity between the forms of crystallization of the two substances, at least in so far as measurements not perfectly accurate would allow him to judge. Notwithstanding these observations, the vast difference between the degrees of specific gravity, being below 2.9 for the one, and above 3.5 for the other, even though all their remaining properties should be found to be identical, will prevent them from being considered as belonging to one and the same species. From the analogy between the iron slags and the hyalosiderite, Dr. Walchner concludes that the rock in which it occurs must be of volcanic origin. The name of the mineral, from ὕαλος, *glass*, and σίδηρος, *iron*, has been suggested to him by its properties and composition. (From Schweigger's *Neues Journal fur Chemie, &c.* 6. ix. p. 65.)

21. *Hopeite, a new mineral.—Form* prismatic. Fundamental form a scalene four-sided pyramid of 139° 41′; 107° 2′; 86° 49′, Plate III. Fig. 29, in which the ratio of the three lines AM : MB : MC = $a : b : c$ is = $1 : \sqrt{4.443} : \sqrt{1.493}$. Combination observed similar to Plate VIII. Fig. 6.

Incidence of M on M over $g = 101° 24′ = \bar{\mathrm{P}}\mathrm{r}$;

of s on s over $l = 81° 34′ = (\breve{\mathrm{P}}\mathrm{r} + \infty)^3$.

Cleavage perfect parallel to $\bar{\mathrm{P}}\mathrm{r} + \infty$ (l), less distinct parallel to $\breve{\mathrm{P}}\mathrm{r} + \infty$ (p). *Surface* of $\breve{\mathrm{P}}\mathrm{r} + \infty$ deeply striated in a vertical direction, the other faces smooth.

Refraction double; two axes, the principal one perpendicular to the axis of P, and also to l. Action of the axis negative. Angle of resultant axes about 48° in the plane of $\mathrm{P} - \infty$ (g), contiguous to the obtuse lateral angle of P. *Index of ordinary Refraction* nearly 1.601. *Colour* grayish-white lustre pearly upon l, vitreous in other directions. *Transparent, translucent.*

Hardness 2.5 . . . 3.0 *Specific gravity* = 2.76 of a perfect crystal. *Phosphorescence* and *Electricity*, none by heat.

This mineral resembles very strongly Anhydrite and Cryolite, being two species of the order *Haloide* of Mohs. It is soluble in acids without effervescence. According to an examination by the help of the blowpipe, instituted by Mr. Nordenskiold of Abo, it consists of some of the stronger acids, like the phosphoric or boracic acid, mixed with zinc, some earthy base, and cadmium. Hopeite occurs sparingly in the cavities of several ores of zinc, found at Altenberg, near Aix-la-Chapelle. This interesting substance has been established into a species by Dr. Brewster, who named it in honour of Dr. Hope.

22. *Childrenite, a New Mineral.*—Mr. Brooke has described the forms of this mineral as being similar to Fig. 3, PLATE VIII. with the following angles:

P on e or e'' = 114° 50′ — e on e' = 130° 20′
P on a = 152° 10′ — edge ee' on edge $e''e'''$ = 92° 46′
P on f = 90°

The forms belong, therefore, to the Prismatic system of Mohs.

Cleavage, not observable. *Hardness,* scratches glass slightly. *Colour,* wine-yellow. This mineral occurs in small apertures, on the surface of crystallized quartz, found in some part of the ground perforated for the canal near Tavistock, in Devonshire. It has been analyzed by Dr. Wollaston, who found it to be a phosphate of alumina and iron. It has been named *Childrenite,* in honour of Mr. Children. It resembles sparry iron ore and heavy spar.—See *Quarterly Journal,* vol. xiii.

23. *Somervillite, a New Mineral.*—The determination of this species is also due to Mr. Brooke, who named it in compliment to Dr. Somerville, from whom he obtained the specimens. The forms of Somervillite are pyramidal. One of the crystals is shown in PLATE VIII. Fig. 4. The inclination of

P on a is = 147° 5′ — M on d = 135°
P on M = 90 — M on M′ = 90
M on e = 161 33

Cleavage, perfect perpendicular to the axis, imperfect, if at all, parallel to M or d. *Hardness* less than that of Idocrase, cross *fracture* more glassy. *Colour,* a very pale dull yellow. Occurs at Mount Vesuvius in cavities with crystallized black mica, and another substance not yet examined. According to Mr. Children, it decrepitates by itself before the blowpipe, and melts alone into a grayish globule, with borax, into a colourless one, while Idocrase does not decrepitate, fuses with more difficulty, and yields globules of a greenish tinge.—See *Quarterly Journal,* v. xvi. p. 274.

24. *Nuttalite, a New Mineral.*—Mr. Brooke has given indications of this mineral, named by him in compliment to Professor Nuttall of Cambridge, Massachussets. It might be mistaken for Scapolite, with which it agrees in its form, which is a right square prism; but it is softer and more glassy in the fracture; it possesses a play of light, resembling that of some Elaeolite from Norway, and a colour likewise approaching to it.

It is imbedded in calcareous spar.—See *Annals of Philosophy*, No. xli. p. 366.

25. *Babingtonite, a New Mineral.*—Forms tetartoprismatic. Crystals observed in the shape of Fig. 5, PLATE VIII.

Incidence of p on m = 92° 34′; p on t = 88°;
t on h' = 155° 25′; m on t = 112° 30′;
m on h' = 137° 5′; p on d' = 150° 25′;
g^1 on m = 132° 15′; h' on g^3 = 89° 20′.

Sometimes the faces marked *m* are wanting. Cleavage, distinct parallel to *p* and *t*. Surface brilliant; colour black; hardness, scratches glass easily. M. Levy discovered this substance in minute crystals, disposed on the surface of certain specimens of cleavelandite, from Arendal, and named it in honour of Dr. Babington. It has been examined by Mr. Children before the blowpipe, who found the indications of silica iron and manganese; he obtained in addition, *via humida*, a considerable proportion of lime. A slight indication was perceived of a minute quantity of titanium.—See *Annals of Philosophy*, No. xl. p. 275.

ZOOLOGY.

26. *The Hyæna Venatica, or Wild African Dog.*—This animal, which is remarkable for hunting in regular packs, is smaller and more slender than the common-shaped hyæna, or the spotted one or *Crocuta.* The general colour is a sandy bay, or an ochraceous yellow, shaded with a darker brown. The whole body is blotched and brindled with black, with occasional spots of white, and the legs are generally marked in the same manner. These marks vary in different individuals, but the more constant ones are a deep black stripe, extending from the nose up to the middle of the face, and between the ears: these are blackish both within and without, and covered with short close hair, which is sometimes very thin: at the interior margin of the ears on the inside, there is a thin and observable tuft of whitish hair: the nose and muzzle are black. The tail is bushy like that of the fox, and is divided in the middle by a ring of black, above which, or towards the insertion, the colour is nearly the same as the general tint of the body; but below, or towards the tail it is white.

The dog, the wolf, and the hyæna, correspond in having six grinders in the upper jaw, and in the lower seven. They also agree in the form and number of their ribs, and lumbar vertrebæ, having seven of the latter. Their ribs, of which there are *thirteen*, are thin and narrow. But both in the striped and spotted hyæna they are *fifteen* in number, and of an extraordinary breadth; and are proportionally much stronger and larger than in any quadruped of their size: in these the grinders are only four, or at most five, and the lumbar vertebræ not more than five.

The present animal, therefore, with respect to its teeth, ribs, and lumbar vertebræ, would be arranged in the genus *Canis,* from which it differs, however, in having only four toes on each foot, and it is said in other essential particulars. With the genus Hyæna it agrees in number of toes, but differs from it in bulk, and in the conformation of the skeleton. These differences were first noticed by Mr. Brookes, who considers it as forming a new genus.

Mr. Burchell, from whose *Travels in Africa,* vol. ii. p. 229, the above account is taken, informs us that he had one of these animals in his possession for thirteen months chained in a stable-yard, and that, during that time, its ferocious nature deterred every person from attempting to tame it; but it became at length so much softened in manners as to play with a common domestic dog. The man, however, who fed it, never durst venture his hand upon it.

27. *Power of the Arctic Dogs.*—Captain Parry has given an interesting account of the power of these animals, and of their great use in dragging anchors, cables, boats, and stores of all kinds from the Hecla to the Fury, which they performed with astonishing ease and expedition. "It was a curious sight," says Captain Parry, "to watch these useful animals walking off with a bower anchor, a boat, or a topmast, without any difficulty; and it may give some idea of what they are able to perform to state, that nine dogs, of Captain Lyon's, dragged 1611 pounds a distance of 1750 yards in nine minutes; and that they worked in a similar way between the ships for seven or eight hours a day. The road was, however, very good at this time, and the dogs the best that could be procured." Page 426.

IV. GENERAL SCIENCE.

28. *Return of the Russian Antarctic Expedition.*—This expedition, under the command of Captain Bellingshausen, has added to our knowledge of the South Polar Regions, by the discovery of two islands within the Antarctic circle, the only land hitherto known to exist so far to the southward. Both these islands lie in about 69° south latitude. One of them, named Alexander I. Island, in 73° west longitude; and the other, Peter Island, in 19° west. Both of them were so closely enveloped in ice, that no particular examination of them could be made. This expedition, consisting of two ships, the Wostok and the Mirni, sailed on the 3d of July 1819. They touched at Copenhagen to improve their equipment, and at Portsmouth to take on board the astronomical instruments which had been ordered for them in London, and from thence proceeded to Teneriffe and Rio Janiero, on their way to the southward. The leading object of the voyage was to explore the Antarctic Regions, and perform a circuit of the southern pole as near to it as the ice would permit; and, avoiding the tract of Captain Cook, to make their highest penetration where this navigator had kept at a distance from the ice, and on the contrary to retire into a more northerly parallel in the meridians where the adventurous Cook had made the most particular examinations. On this judicious plan they succeeded in the discovery of the two islands we have mentioned; but they could not approach within thirty miles of them for ice, and that only on the *west* side. The ice was generally found to lie so far from the pole, that their highest latitude was only 70 degrees, being short of the point reached by Cook. Within the antarctic circle they traversed a distance of near 30 degrees

of longitude; and taking the latitude of 60 degrees, we find that 300 degrees of longitude were traced in the two voyages by Cook and Bellingshausen within this parallel, leaving only 60 degrees of longitude unexplored at this elevation.—*App. to Art. Polar Regions*, by Mr. Scoresby, in the *Edinb. Encyclopædia*, Vol. XVII. Part I. about to appear.

29. *Impermeability of Glass to Water under high pressure.*—It was lately maintained by Mr. Deuchar, in a paper in the *Philosophical Magazine*, vol. lx. p. 310, that from the porous nature of certain siliceous bodies, it was extremely probable that the fluids in minerals had been forced through their mass by pressure, and that the water which is found in well-stopped bottles, when sunk to great depths in the ocean, has been forced through the pores of the glass.

The Rev. Mr. Campbell, in a voyage to South Africa, carried out with him two crystal globular bottles, hermetically sealed, and made on purpose, by Messrs. Pellet and Green, St. Paul's Churchyard. In Lat. 14°27′N. and to the W. of the Cape de Verd Islands, they were sunk from on board the Westmoreland, to a depth of 200 fathoms, or 1200 feet, by means of two leads, the one of 22 and the other of 28 lbs. When the rope was brought up, by the exertion of *ten* men, for a quarter of an hour, *the two globular bottles were found empty.* A wine bottle, sent down at the same time, corked and plastered over with rosin, came up full of water, with the cork inverted; five other bottles were full of water, but the corks and rosin of these were in the same state as when let down. Another wine bottle had the pitch remaining entire on its mouth, but the inside was nearly full of water, in which also the cork was swimming. The water in the inside of the bottles was not more fresh than before its entrance. Campbell's *Second Journey in Africa*, vol. ii. p. 383.

ART. XXXII.—LIST OF PATENTS FOR NEW INVENTIONS, SEALED IN ENGLAND SINCE JANUARY 1, 1824.

Jan. 1. FOR *Improved Methods of Freezing Water.* To JOHN VALLANCE.

Jan. 8. For an improvement on the French *Military Mill for Grinding Wheat*, &c. To FRANCIS DEVEREUX, London.

Jan. 15. For an *Improved Umbrella.* To JOSEPH FOOT, London.

Jan. 15. For a *Floating Breakwater.* To JOHN WHYTE, London. An account of this invention will be found in this Number, p. 145.

Jan. 15. For Improvements on *Ploughs* and *Harrows.* To JOHN FINLAYSON, Ayrshire.

Jan. 15. For Improvements in *Fermented Liquors*, and their products. To JEAN LE GRAND.

Jan. 19. For *Improvements on the Clarionet.* To WILLIAM GOTTERIDGE, Cork.

Jan. 19. For *Improved Machinery for Grinding Colours.* To GEORGE POLLARD, London.

Jan. 19. For *Improved Tubes for Gas*, and other purposes. To JAMES RUSSELL, Wednesbury.

Jan. 19. For an Improved Method of *Manufacturing and Purifying Inflammable Gas*, by means of Atmospheric Air. To Simeon Broadmeadow, Abergavenny.

Jan. 19. For Improvements in *Tanning Hides*, &c. To Howard Fletcher, Walsall.

Jan. 24. For Improvements in *Wheel Carriages*. To Thomas Bewley, Queen's Court, Ireland.

Jan. 24. For Improved Methods of *Figuring and Ornamenting various Fabrics*. To John Heathcoat, of Tiverton.

Jan. 27. For Improved Machinery and Instruments for *Dressing* and *Cleaning Cloths and Fabrics* of all kinds. To John Jones, Leeds.

Feb. 7. For an Improved *Method of Stamping*. To Sir William Congreve, Bart.

Feb. 10. For the *Diorama*, or an Improved Method of exhibiting Pictures, and of Distributing and Directing the Day-light on them. To John Arrowsmith, Piccadilly. Partly communicated by a foreigner.

Feb. 10. For a *New Constructed Hat*. To R. Lloyd, and J. Rosbotham, Blackfriar's Row.

Feb. 19. For improved *Waistbands, Bandages*, and *Supporters of Dress*, &c. To Henry Adcock, Birmingham.

Feb. 19. For Improvements in *Printing Machines*. To Mr. William Church, Birmingham.

Feb. 19. For Improvements in *Printing Machines*. To Aug. Applegath, Blackfriars.

Feb. 19. For Improvements to *Obviate Concussion in Machinery*, by which friction is converted into an useful power. To the Rev. Moses Isaacs, London.

Feb. 19. For a *Quick Method of Communicating Intelligence, and Conveying Parcels and Goods*, &c. To John Vallance, Brighton.

Feb. 28. For Improvements in *Paving Horse and Carriage Ways*. To A. H. Chambers, New Bread Street.

Feb. 28. For a method of *Roasting Coffee*, &c. and Improvements in the Machinery employed. To R. Evans, Bond Street.

Feb. 28. For a Process of making a *Certain Material a suitable Substitute for Leather*. To John Gunby, N. Kent Road.

Feb. 28. For a New Method of *Combining and Applying certain Kinds of Fuel*. To John Christie, Mark Lane.

Feb. 28. For an *Apparatus to be Applied to a Windlass*. To William Yetts, Great Yarmouth.

Feb. 28. For a *Metallic Frame Glass for Hot-houses, and all Inclined Lights*. To J. W. Richards, Birmingham.

Feb. 28. For Improved *Harness for One Horse Carriages*. To William Greaves, Sheffield.

Feb. 28. For Improved *Rail* and *Iron Roads*. To W. James.

Feb. 28. For an Improved way of *Constructing and Placing a Coke Oven near Steam, or other Boilers, to save Fuel*. To Maurice de Jough.

Feb. 28. For a *Liquid for making Leather, &c. Water-proof*. To C. B. Fleetwood, Dublin.

March 6. For improved *Pump Machinery*. To Joel Spiller.

March 9. *Three* separate patents for improvements in *Lace, Weaving, and Spinning Machinery*. To John Heathcoat, Tiverton.

March 1. For Improvements in *Lace Machine*. To W. D. Mosley.

March 15. For Improvements in *Lace Machinery*. To W. Morley.

March 20. For a new method of *Preparing and Manufacturing Safflower* (Corthamus) *as a dye or red colouring matter*. To Rupert Kirk.

March 20. For a *Machine to make, from one Piece of Leather, without seams, Shoes, Gloves, Caps, Hats, Sheaths*, &c. To J. H. Petelpierre, Somers' Town.

March 20. For an *Instrument for finding the Cubic Contents of Standing Timber*. To James Rogers, Marlborough.

March 20. For Improvements on the *Bobbin-Net Lace Machinery*. To John Longford, Nottingham.

March 20. For Improved *Machinery to spin Cotton, Wool, or Silk*. To John Heathcoat, Tiverton.

March 20. For an Improved *Apparatus for Producing Light*. To Henry Berry, Abchurch Lane, London.

March 20. For Improved *Distilling Apparatus*, partly communicated from abroad. To J. J. Stainmare, Vauxhall.

March 22. For an *Apparatus for Manufacturing and Burning Oil Gas*, communicated from abroad. To Charles Demeny, Fenchurch Street, London.

March 25. For *Machinery for picking and preparing Flax, threshing Grain, and sheeling Clover*, &c. To Namen Goodsell, London.

March 27. For Improved *Water-Closets*. To Edw. Jordan, Norwich.

April 7. For Improvements in *Furnaces and Forges for preparing Iron or Steel, and making Rails*, &c. To Joseph Spencer, Belfast.

April 7. For an Improved *Cloth called British Cashmere*. To James Schofield, Rastnick.

April 8. For *the Useful and Elegant Facilitator for-Shaving*. To Thomas Ryalls, Sheffield.

Art. XXXIII.—LIST OF PATENTS GRANTED IN SCOTLAND

Since 18th March, 1824.

1. For Improvements in the *Machinery for Working Pumps*. To Joel Spiller, of Chelsea. 2d March, 1824. Written to the Seal, &c. 18th March, 1824.

2. For Improvements in the Process of, and *Apparatus for Distilling*. To Jean Jacques-Stainmare, of Belmont Distillery, Wandsworth, County of Surrey, distiller.

3. For an Apparatus or Improved *Method* of *Reefing Sails*. To Daniel Tonge of Liverpool, Lancastershire, ship-owner. Written to the Seal, &c. 29th April, 1824.

4. For an *Improved Fid* for the upper masts of ships. To Benjamin Rotch, Esq. of Furnival's Inn. Written to the Seal, &c. 29th April, 1824.

5. For Improvements in the *Machinery* and *Process of making Metallic Plates, Rollers, Pipes, Cylinders,* &c. To Thomas Gethen, Esq. Henry Street, Pentonville. Written to the Seal, &c. 29th April, 1824.

6. For the manufacturing or making of an Elastic Fabric from *Whalebone,* and the manufacturing or making of Elastic Fabrics from Whalebone, Hemp, and other materials combined, suitable for making into *Elastic Frames or Bodies for Hats, Caps, and Bonnets,* and also the manufacturing or making of such Elastic Frames or Bodies from the same materials, by the mode of plaiting. To John Gibson, hat-maker, Glasgow. Written to the Seal, &c. 19th May, 1824.

7. For an *Apparatus to be applied to a Windlass.* To William Yetts of Great Yarmouth, Norfolk, merchant. Warrant dated at Carlton-House, 5th May, 1824. Written to the Seal, &c. 19th April, 1824.

Art. XXXIV.—CELESTIAL PHENOMENA,

From July 1, to October 1, 1824, calculated for the Meridian of Edinburgh. By Mr. George Innes, Aberdeen.

These calculations are made for Astronomical time, the day beginning at noon. The Conjunctions of the Moon and Stars are given in Right Ascension.

JULY.

D.	H.	M.	S.	
3	1	25	55	☌ ☽ ♂
3	2	22	3	☽ First Quarter.
5	11	47	15	☍ ☉ ♅
7	3	34	40	☌ ☽ ☌ ♏
8	7	49	—	☌ ☽ B Oph.
10	6	53	—	☌ ☽ ♅
10	16	12	36	○ Full Moon.
14	18	28	28	☌ ☉ ♃
18	17	10	—	☌ ♀ ♃
18	19	49	19	☾ Last Quarter.
21	6	6	—	☌ ☽ ♄
21	9	40	—	☌ ☿ ♃
22	11	43	11	☉ enters ♌
23	5	3	—	☌ ☽ 132 ♉
24	9	30	—	☌ ☿ ♀
25	6	43	28	☌ ☽ ♃
25	13	32	—	☌ ☉ ☿
25	17	27	—	☌ ☽ ♀
25	19	2	11	● New Moon.
25	19	36	—	☌ ☽ ☿
27	0	28	—	☌ ☽ δ ♌
27	8	35	—	☌ ☽ π ♌
29	1	43	32	☌ ☉ ♀

AUGUST.

D.	H.	M.	S.	
1	0	40	—	☌ ♄ s ♉
1	9	36	47	☽ First Quarter.
3	9	7	—	☌ ☽ σ ♏
3	10	3	48	☌ ☽ ♅
7	0	—	—	☿ near a ♌
9	7	24	49	○ Full Moon.
14	21	—	—	♀ near a ♌
17	8	23	15	☾ Last Quarter.
17	13	11	—	☌ ☽ η ♉
18	8	45	—	☌ ☽ ♄
19	14	34	—	☌ ☽ 132 ♉
22	2	40	—	☌ ☾ ♃
22	18	6	31	☉ enters ♍
23	16	4	—	☌ ☿ β ♉
24	2	15	58	● New Moon.
24	14	49	—	☌ ☽ ♀
25	19	17	—	☌ ☽ ☿
29	0	10	—	☌ ☽ ♂
30	20	30	4	☽ First Quarter.

SEPTEMBER.

D.	H.	M.	S.		D.	H.	M.	S.	
2	11	49	—	☌ ☽ 1 ν ♉	20	16	40	20	Im. I. Sat. ♃
2	14	36	—	☌ ☽ ♅	22	10	6	32	● New Moon.
7				☿ Greatest Elong.	23	12	40	—	☌ ☽ ♀
7	11	23	57	○ Full Moon.	23	14	36	15	☉ enters ♎
12	12	50	—	☌ ☽ η ♍	23	15	40	—	☌ ☽ ☿
13	14	46	34	Im. I. Sat. ♃	25	19	54	—	☌ ☽ ♂
13	19	22	—	☌ ☽ α ♉	27	8	—	—	☿ near a ♍
14	14	40	—	☌ ☽ ♄	28	15	10	48	☽ First Quarter.
15	18	49	56	☾ Last Quarter.	29	17	38	—	☌ ☽ 1 ν
16	11	51	—	☌ ☽ μ ♊	29	21	37	—	☌ ☽ ♅
18	20	51	—	☌ ☽ ♃					

Eclipse of the Moon.

On the 10th of July, there will be a small Eclipse of the Moon, *partly visible;* The times are as follows:

		D.	H.	M.	S.
The Eclipse begins,	July	10	15	17	35
Moon sets Eclipsed,		—	15	41	40
Middle of the Eclipse,		—	16	1	46
Ecliptic opposition,		—	16	12	36
End of the Eclipse,		—	16	45	57

Digits Eclipsed, 1° 38′ 11″, on the south part of the Moon's Disc.

Occultation of the Georgian Planet.

On the 6th of August there will be an Occultation of the *Georgian Planet* by the Moon. The following are the elements and principal results of a calculation for Edinburgh.

	D.	H.	M.	S.
Geocentric ☌ of the ☽ and ♅, Edinburgh, *Mean Time*, August,	6	10	3	48,09
——— ——— apparent time,		9	58	18,20
Geocentric Conjunction in Longitude,		282°	36	42,36
Sun's Right Ascension,		136	45	43,39
—— horary motion in Right Ascension,			2	23,62
Obliquity of the Ecliptic,		23	27	44,40
Moon's Latitude North increasing,			18	24,19
Geocentric Latitude of ♅ South,			25	7,43
Moon's horizontal parallax for the Latitude of Edinburgh,			54	25,90
—— horizontal semidiameter,			14	52,01
—— horary motion in Longitude at the instant of conjunction,			30	4,86
——— for the hour preceding,			30	5,26
——— for the hour following,			30	4,47
—— horary motion in Latitude at the instant of conjunction,		+	2	44,67
——— for the hour preceding,		+	2	44,73
——— for the hour following,		+	2	44,61

The following are the principal results in making the calculation for Edinburgh, reduced Latitude 55° 47′ 32″ N.; Longitude in time 12′ 41,4″ West of Greenwich.

Apparent Time.	For the Immersion.						For the Emersion.					
	H.	M.	S.	H.	M.	S.	H.	M.	S.	H.	M.	S.
Instants assumed,	9	46	18,20	9	47	18,20	10	52	18,20	10	53	18,20
Right Ascension of the Meridian,	283°	19	47,67	283	34	50,06	299	52	25,65	300	7	28,04
Moon's Longitude,	282	30	41,47	282	31	11,57	283	3	46,15	283	4	16,22
——— true Latitude N.		17	51,26		17	54,00		20	52,35		20	55,07
Altitude of the Nonagesimal,	12	27	47,5	12	31	25,0	17	40	28,3	17	46	38,6
Longitude of the Nonagesimal,	306	54	25,9	307	30	7,5	337	10	19,2	337	32	15,1
Parallax in Longitude,		— 4	52,03		— 5	0,07		— 13	25,55		13	33,74
Parallax in Latitude,		53	15,52		53	14,78		51	56,96		51	55,17
Appar. diff. Long ☽ and ♃		10	53,02		10	30,96		13	38,14		14	0,26
Appar. diff. Lat. ☽ and ♃		10	16,83		10	13,35		5	57,18		5	52,66
Moon's Appar. mot. in 1 of time,						18,34						23,14
Errors from Instants assumed,			— 0,74			+ 17,60			— 6,43			+ 16,71

	D.	H.	M.	S.		D.	H.	M.	S.
Immersion	6	9	46	22,66	Emersion	6	10	52	37,87

No allowance has beeen made for the horary motion of the Planet.

The following are the final results, in Astronomical Mean time.

	D.	H.	M.	S.		
Immersion August	6	9	51	52,56	at 10′ 16″ 8 N.	at the ☽'s centre.
Emersion ———		10	58	7,52	5′ 55″ 9 N.	

Observations on the Occultation of the 5th of April, 1824.

At Aberdeen, the evening of the 5th of April was very favourable for observing the occultation of Jupiter and his satellites by the moon, in as far as regarded the immersions. The following are the times of these phenomena; after allowing for the error and rate of the clock, which were ascertained by transits of the sun.

	By Observation.				*By Calculation.*			
	D.	H.	M.	S.	D.	H.	M.	S.
Immersion of the 3d satellite, April	5	11	6	52,7				
——————— 1st ———————		11	10	5,2				
First external contact - -		11	17	37,7	5	11	17	2,53
First internal contact - -		11	18	40,2		11	18	7,81
Immersion of the 2d satellite -		11	22	25,7				
Second internal contact - -		12	9	12,5	12	8	51	03
Second internal contact - -		12	10	15,5	12	9	52	83

The immersion of the 4th satellite happened at so short an interval from that of the planet, that it could not be conveniently attended to. The times of the immersions are supposed to have been obtained to the nearest half second; but a haze, which afterwards accompanied the moon, rendered the two observations of the planet subject each to an uncertainty of two or three seconds. The telescope used was a 3½ feet achromatic one, by Dollond, with a power of about 70. *

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* An observation of this occultation at Inchbonny, near Jedburgh, will be found in pages 179, 180. Ed.

ART. XXXV.—REGISTER OF THE BAROMETER, THERMOMETER, AND RAIN-GAGE, *kept at Canaan Cottage*. By ALEX. ADIE, Esq. F.R.S. Edinb.

The observations contained in the following Register are made at Canaan Cottage, the residence of Mr. Adie, by means of very nice instruments, constructed by himself. Canaan Cottage is situated about 1½ mile to the south of Edinburgh Castle, about 3 miles from the sea at Leith, and about 1¼ of a mile N. of the west end of Blackford Hill. The ridge of Braid Hills is about 1 mile to the south, and the Pentland Hills about 4 miles to the west of south. The height of the thermometer is about 260 feet above the level of the sea. The morning and evening observations were made about 10 A.M. and 10 P.M.

JANUARY 1824.											FEBRUARY 1824.											MARCH 1824.										
D. of Week.	Day of Month.	Thermometer.			Register Therm.			Barometer.		Rain.	D. of Week.	D. of Mon.	Thermometer.			Register Therm.			Barometer.		Rain.	D. of Week.	D. of Mon.	Thermometer.			Register Therm.			Barometer.		Rain.
		Morn.	Even.	Mean.	Min.	Max.	Mean.	Morn.	Even.				Morn.	Even.	Mean.	Min.	Max.	Mean.	Morn.	Even.				Morn.	Even.	Mean.	Min.	Max.	Mean.	Morn.	Even.	
T.	1	41	42	41.5	35	43	39	28.56	28.46	.22	S.	1	42	40	41	34	47	40.5	29.52	29.59		M.	1	35	29	32	32	40	36	29.48	29.45	.10
F.	2	42	40	41	39	45	42	29.21	29.73		M.	2	44	38	41	33	49	41	29.71	29.81		T.	2	30	35	32.5	27	36	31.5	29.46	28.85	.09
S.	3	40	44	42	31	44	37.5	30.00	30.11		T.	3	44	44	44	33	45	39	29.57	29.27	.21	W.	3	32	26	29	30	34	32	28.90	29.45	.04
S.	4	44	43	43.5	40	45	42.5	30.18	30.15		W.	4	42	38	40	36	44	40	29.25	29.32		T.	4	33	39	36	23	38	30.5	29.34	28.83	.05
M.	5	45	43	44	42	45	43.5	30.10	29.85		T.	5	38	36	37	32	41	36.5	29.49	29.45	.02	F.	5	41	33	37	35	43	39	29.00	29.35	
T.	6	42	34	38	40	43	41.5	29.82	30.16		F.	6	38	46	42	31	41	36	29.61	29.38	.10	S.	6	46	47	46.5	30	50	40	29.18	28.88	.02
W.	7	35	39	37	25	38	31.5	30.16	29.88		S.	7	50	50	50	40	51	45.5	29.65	29.48	.03	S.	7	42	36	39	37	45	41	28.82	29.11	.03
T.	8	45	49	47	34	46	40	29.70	29.75		S.	8	47	39	43	44	50	47	29.88	30.15	.01	M.	8	36	35	35.5	32	38	35	28.40	28.85	.32
F.	9	52	53	52.5	46	54	50	29.78	29.78		M.	9	42	43	42.5	32	45	38.5	30.15	30.15		T.	9	37	32	34.5	30	42	36	29.22	29.35	
S.	10	50	36	43	49	50	49.5	29.73	30.02		T.	10	47	37	42	37	48	42.5	29.88	29.95	.01	W.	10	36	33	34.5	28	41	34.5	29.62	29.72	
S.	11	39	40	39.5	32	42	37	30.15	30.04		W.	11	42	40	41	34	46	40	30.05	29.83		T.	11	42	34	38	31	45	38	29.19	29.11	
M.	12	43	42	42.5	39	45	42	30.03	30.08		T.	12	47	37	42	38	48	43	29.28	28.55	.32	F.	12	39	31	35	31	42	36.5	28.99	28.80	.04
T.	13	43	42	42.5	41	43	42	30.15	30.05		F.	13	39	39	39	33	42	37.5	28.42	28.82		S.	13	39	33	36	28	43	35.5	29.33	29.00	.02
W.	14	41	29	35	40	44	42	30.25	30.32		S.	14	38	36	37	35	40	37.5	29.23	29.24	.15	S.	14	39	37	38	28	47	37.5	29.68	29.68	
T.	15	31	29	30	25	37	31	30.31	30.46		S.	15	35	34	34.5	26	39	32.5	29.23	29.20		M.	15	42	46	44	35	57	46	29.42	29.42	
F.	16	32	33	32.5	23	36	30.5	30.46	30.38		M.	16	40	36	38	29	43	36	29.12	29.05		T.	16	45	41	43	41	52	46.5	29.40	29.52	.02
S.	17	39	40	39.5	30	41	35.5	30.28	30.15		T.	17	36	33	34.5	30	40	35	29.07	29.10		W.	17	47	47	47	38	53	45.5	29.83	29.86	
S.	18	44	43	43.5	38	45	41.5	30.13	30.03		W.	18	38	38	38	31	41	36	28.92	29.07	.33	T.	18	51	43	47	45	57	51	29.82	29.96	.03
M.	19	42	39	40.5	39	45	42	29.96	29.94		T.	19	44	39	41.5	32	46	39	29.27	29.42	.02	F.	19	50	47	48.5	38	58	48	30.03	29.91	
T.	20	42	39	40.5	38	43	40.5	29.80	29.47		F.	20	39	40	39.5	36	43	39.5	29.50	29.55		S.	20	52	47	49.5	45	56	50.5	29.94	29.86	.03
W.	21	41	37	39	36	42	39	29.18	29.02	.02	S.	21	39	38	38.5	37	42	39.5	29.57	29.61	.07	S.	21	47	38	42.5	42	53	47.5	29.59	29.48	.36
T.	22	38	35	36.5	34	41	37.5	28.80	28.49	.16	S.	22	42	40	41	37	44	40.5	29.80	29.74		M.	22	43	32	37.5	29	49	39	29.52	29.70	.03
F.	23	36	36	36	32	40	36	28.42	29.13		M.	23	39	39	39	37	42	39.5	29.80	29.80	.09	T.	23	39	39	39	27	44	35.5	29.91	30.05	.06
S.	24	39	47	43	31	41	36	29.35	29.10	.18	T.	24	40	39	39.5	36	44	40	29.80	29.67		W.	24	40	39	39.5	38	44	41	29.39	29.11	
S.	25	45	50	47.5	43	48	45.5	29.33	29.35	.16	W.	25	40	37	38.5	37	43	40	29.70	29.73	.10	T.	25	43	40	41.5	38	46	42	29.11	29.11	
M.	26	51	46	48.5	46	52	49	29.38	29.32	.13	T.	26	38	36	36	32	40	36	29.75	29.70	.24	F.	26	39	37	38	37	46	41.5	29.99	29.87	
T.	27	44	38	41	40	44	42	29.28	29.24		F.	27	36	36	37	32	39	35.5	29.68	29.80	.01	S.	27	43	35	39	35	44	39.5	29.76	29.88	
W.	28	39	34	36.5	33	42	37.5	29.05	29.35	.01	S.	28	40	39	39.5	34	42	38	29.85	29.78		S.	28	39	39	39	32	45	38.5	29.92	29.80	
T.	29	36	31	33.5	31	40	35.5	29.58	29.75		S.	29	39	37	38	37	44	40.5	29.79	29.53		M.	29	44	39	41.5	34	48	41	29.66	29.52	
F.	30	38	45	41.5	26	42	34	29.67	29.45													T.	30	38	30	34	34	46	40	29.55	29.56	.10
S.	31	45	41	43	40	47	43.5	29.46	29.45													W.	31	35	28	31.5	28	40	33	29.59	29.61	
	Sum,	1284	1239	1261.5	1120	1353	1236.5	920.27	920.44	0.87			1185	1124	1154.5	995	1269	1132	856.54	855.75	1.73			1264	1147	1205.5	10.36	14.22	12.29	913.05	912.60	1.34
	Mean,	41.43	39.97	40.70	36.13	43.65	39.89	29.686	29.692				40.86	38.76	39.81	34.31	43.78	39.03	29.536	29.509				40.77	37.	38.89	33.42	45.87	39.64	29.452	29.439	

Mr. Adie's *Register of the Barometer, Thermometer and Rain-Gage*—continued.

APRIL 1824.

D. of Week.	Day of Month.	Thermometer.			Register Therm.			Barometer.		Rain.
		Morn.	Even.	Mean.	Min.	Max.	Mean.	Morn.	Even.	
T.	1	37	37	37	24	39	31.5	29.38	28.78	.27
F.	2	40	30	35	34	43	38.5	29.47	29.74	
S.	3	40	34	37	26	44	35	29.85	29.92	
S.	4	43	41	42	25	49	37	30.08	30.18	
M.	5	45	42	43.5	38	53	45.5	30.21	30.28	
T.	6	46	45	45.5	31	55	43	30.36	30.24	
W.	7	48	43	45.5	41	52	46.5	30.20	30.20	
T.	8	50	36	43	42	54	48	30.20	30.18	
F.	9	48	42	45	32	55	43.5	29.86	29.34	
S.	10	40	30	35	34	43	38.5	29.40	29.20	.07
S.	11	40	36	38	27	44	35.5	29.00	29.05	.02
M.	12	45	35	40	31	48	39.5	29.06	29.17	
T.	13	42	33	37.5	27	49	38	29.30	29.43	
W.	14	43	34	38.5	27	52	39.5	29.56	29.62	
T.	15	45	35	40	24	53	38.5	29.63	29.48	
F.	16	40	40	40	25	47	36	29.43	29.48	.01
S.	17	43	33	38	35	47	41	29.55	29.72	
S.	18	47	39	43	27	59	43	29.85	29.92	
M.	19	51	51	57	30	65	47.5	29.90	29.86	
T.	20	56	50	53	49	65	57	29.98	29.95	
W.	21	61	49	55	36	70	53	29.80	29.55	
T.	22	54	48	51	45	61	53	29.35	29.43	
F.	23	50	43	46.5	42	57	49.5	29.39	29.49	
S.	24	57	45	51	39	63	51	29.80	29.79	
S.	25	56	49	52.5	47	62	54.5	29.75	29.42	.06
M.	26	54	49	51.5	46	62	54	29.30	29.25	
T.	27	55	49	52	42	61	51.5	29.37	29.34	
W.	28	56	52	54	45	62	53.5	29.32	29.18	.14
T.	29	57	53	55	47	69	58	29.22	29.12	
F.	30	58	51	54.5	48	64	56	29.11	29.23	
	Sum,	1477	1254	1350.5	1066	1647	1356.5	888.68	887.44	0.57
	Mean,	48.23	41.8	45.02	35.53	54.9	45.22	29.628	29.58	

MAY 1824.

D. of Week.	D. of Mon.	Thermometer.			Register Therm.			Barometer.		Rain.
		Morn.	Even.	Mean.	Min.	Max.	Mean.	Morn.	Even.	
S.	1	58	48	53	47	64	55.5	29.55	29.71	
S.	2	55	46	50.5	36	65	50.5	29.82	29.76	
M.	3	51	40	45.5	39	53	46	29.65	29.44	.42
T.	4	47	46	46.5	39	57	48	29.42	29.50	
W.	5	53	44	48.5	40	60	50	29.59	29.62	
T.	6	50	45	47.5	32	57	44.5	29.70	29.75	
F.	7	52	51	51.5	43	62	52.5	29.68	29.81	
S.	8	52	45	48.5	45	63	54	30.09	30.14	
S.	9	52	52	52	34	63	48.5	30.05	29.96	
M.	10	56	44	50	43	63	53	29.88	29.96	
T.	11	47	42	44.5	40	57	48.5	29.97	29.89	
W.	12	48	39	43.5	37	56	53	29.88	29.83	.02
T.	13	48	43	45.5	30	55	48.5	29.75	29.75	
F.	14	46	42	44	38	52	45	29.76	29.69	
S.	15	47	43	45	39	58	48.5	29.68	29.72	
S.	16	47	47	47	37	62	49.5	29.82	29.80	
M.	17	55	47	51	37	63	50	29.70	29.72	.02
T.	18	52	38	45	37	57	47	29.60	29.58	.15
W.	19	46	36	41	30	52	41	29.64	29.56	
T.	20	45	36	40.5	30	51	40.5	29.57	29.67	
F.	21	45	40	42.5	29	55	42	29.77	29.84	
S.	22	52	48	50	32	59	45.5	29.83	29.75	
S.	23	55	51	53	45	68	56.5	29.72	29.76	
M.	24	58	51	54.5	49	66	57.5	29.82	29.95	
T.	25	59	49	54	45	70	57.5	30.02	30.11	
W.	26	58	50	54	42	69	55.5	30.27	30.35	
T.	27	65	54	59.5	44	73	58.5	30.42	30.40	
F.	28	62	48	55	43	73	58	30.38	30.22	
S.	29	49	49	49	44	51	47.5	30.15	29.93	
S.	30	60	49	54.5	47	71	59	29.72	29.64	
M.	31	53	49	51	45	62	53.5	29.70	29.81	.02
		1623	1412	1517.5	1218	1887	1552.5	924.60	914.62	.63
		52.35	45.55	48.95	39.29	60.87	50.08	29.826	29.503	

THE EDINBURGH JOURNAL OF SCIENCE.

Art. I.—*A Biographical Account of* J. H. Van Swinden, *A. L. M. Phil. Doct. F. R. S. Lond. and Ed. Professor of Natural Philosophy, and Member of the Royal Institute of Arts and Sciences of the Netherlands.* By G. Moll, *Professor of Natural Philosophy in the University of Utrecht.* Communicated by the Author.

Mr. Van Swinden was born at the Hague, on the 8th June, 1746. His father, an eminent barrister, intended to bring up his son to the same profession, and with this view he watched his early education with the tenderest care. The young Van Swinden, however, soon showed a disposition to studies of a different kind; and he took peculiar delight in calculating, drawing, watchmaking, and mechanical pursuits. Blassiere, author of some good mathematical treatises, was his teacher in that department of science; but the young pupil soon outstripped his tutor. At an early age he was sent to the university of Leyden, where he had the good fortune of meeting with Mr. Hennert, afterwards my predecessor in the university of Utrecht, and then private lecturer in Leyden. Hennert, a staunch Eulerian analyst, initiated his friend into all the intricacies of the modern calculus.

It was, however, intended that Mr. Van Swinden's principal study should be the law; but the strong bent which his mind had taken towards studies of another sort was not to be counteracted. If a sense of duty prompted him to attend the lectures of the professors of law, a natural inclination made him eagerly follow those given in that department of science which he was destined to adorn.

Even at the commencement of his philosophical career, Mr. Van Swinden was struck with the eminent qualities of the celebrated Sir Isaac Newton, as a mathematician, as a writer, and as a philosopher. The works of that great man were among the chief objects of his study in the university; and when he was about to leave it, his dissertation *de Attractione*, with which he took his degree, abundantly showed how deeply he had entered into the views of the author of the *Principia.*

He afterwards appeared to have seized every opportunity of explaining and illustrating the philosophical method of Sir Isaac. At the early age of 20, (1767,) when he was called to the chair of natural philosophy in the university of Franeker, he opened his lectures with a discourse, *De causis errorum in rebus philosophicis.* On another opportunity (1779) he spoke *de philosophia Newtoniana;* and when he was afterwards called from Franeker to Amsterdam, (1785,) he again opened his lectures with a discourse, *De hypothesibus physicis, quomodo sint e mente Newtoni intelligendae.* In all these discourses, which have been printed, that sober-minded philosophy which has its foundation in experiment and induction, and of which he acquired a taste in the writings of Chancellor Bacon and Sir Isaac Newton, is strongly recommended; and there exists perhaps no better antidote against the poisonous influence of that mystical and hypothetical manner of treating subjects of natural philosophy now so common, than the perusal of these writings of Mr. Van Swinden.

At Franeker, the tranquillity of a small town gave full scope to his ardour for study. He would often not stir from home for weeks together, and all his time was divided between his closet, his pupils, and his observations. This overstraining of his faculties had its usual effects; his health was impaired, and the mineral waters of Spa, Aix-la-Chapelle, Pyrmont, were frequently resorted to, in order to restore his strength, and above all, to drive him from his study. He entered with ardour into all the new discoveries of that period, either in natural philosophy or chemistry, and kept up an extensive correspondence with many of the most prominent scientific characters of that time, as Charles Bonnet, Spallanzani, T. A. Euler, Saussure, De Luc, Dr. Maty, Wilcke, Bertholon, Lalande, &c.

The subjects of meteorology, electricity, and magnetism, then particularly engaged his attention; and he applied himself with unremitting zeal to such observations as were likely to throw some new light on these interesting subjects. Amongst his earliest writings, is his *Tentamen de Magnete*, published in 1772, in which he exposes his mathematical theory of what he calls the *punctum culminans*.

During the long space of ten years, the magnetic variation was actually observed every *hour of the day* by Mr. Van Swinden, or his pupils. With equal care, during thirteen years, he kept an exact register of the barometer, thermometer, and hygrometer. No circumstance relating to atmospheric phenomena escaped his attention; no aurora borealis appeared during his residence in Franeker but what was accurately observed. Part of his house and garden were arranged as an observatory. His friends, his pupils, even his servants, sustained the parts of observers during such absences as he was compelled to make. Even in other parts of the country he procured observers, to whom he gave directions and encouragement. By these means, he collected an immense number of facts relating to the subjects of his investigation, whilst by unremitting study, and an excellent memory, he acquired a degree of learning which may almost be said to be unrivalled.

His *Recherches sur les aiguilles aimantées*, to which the Academy of Sciences of Paris adjudged the prize, (1777,) contain such a vast number of observations, and such a variety of curious facts relating to magnetical phenomena, as are seldom found in any writer on natural philosophy. When the Academy of Bavaria (1776) proposed as a prize question the investigation of the analogy between magnetism and electricity, Van Swinden received the *program* so late as to leave him only a few days to prepare an answer to the question. But he had thoroughly considered the subject. The experiments required had been made long before; and the first medal was awarded to him. This paper, together with some others on the same subject, he translated afterwards from Latin into French; and they are well known to philosophers under the title of *Mémoires sur l'Analogie de l'Electricité et du Magnétisme*, 1784.

The ancestors of Mr. Van Swinden were refugees, who had been driven from France by the revocation of the edict of Nantes. The domestic use of the language of their forefathers subsisted among these refugees for many generations; and Mr. Van Swinden under the paternal roof, had had the opportunity of making himself so completely master of the French language, as to speak and write in it with that elegance and correctness, which Frenchmen contend to be almost beyond the reach of foreigners. Many of the works of Mr. Van Swinden were accordingly written in French. Thus his excellent work on thermometers, and two others on meteorological observations, are all written in that language, and this circumstance certainly contributed greatly to extend his reputation over all Europe. The *Journal de Physique*, the *Journal des Savans*, the Memoirs of the Academies of Berlin, Paris, of the Royal Society, of the Academies of Turin, Brussels, Haarlem, Petersburg, contain many of his papers. When Charles Bonnet's *Contemplations de la Nature* were translated into Dutch, Mr. Van Swinden made many additions and notes, which Bonnet judged so important as to have them inserted in subsequent French editions of his work.

M. Biot, in his Treatise on Natural Philosophy, tom. iii. page 143, asserts that we are indebted to Cassini IV. for whatever we know about the diurnal variation of the needle. This, I think, is not fair. We do not mean to undervalue M. Cassini's observations, but it is unquestionable that, long before the publication of that philosopher's work, Mr. Van Swinden had observed and published that which M. Biot less accurately is pleased to ascribe to his countryman. In this respect, however, Mr. Van Swinden was treated with more justice by other eminent French philosophers, such as Haüy, Halley, and Burkhardt.

Among all these various occupations which took up Van Swinden's time at Franeker, he applied himself with assiduity to various branches of mathematics, as political arithmetic, the doctrine of chances, mortality, tontines, &c. In the works of the Haarlem Society, he gave a new demonstration of Newton's formula of the binomial theorem.

Van Swinden performed his academical duties with strict care. His numerous pupils, and their progress and success in life, showed his abilities as a teacher to great advantage. The newest discoveries in science were introduced into his lectures. He endeavoured to communicate useful knowledge to his pupils, whilst he guarded them constantly against the baneful influence of that hypothetical mode of reasoning which began at that time to prevail among philosophers.

In 1785, he accepted the situation of professor of philosophy at Amsterdam, thus changing his habitation from the small and tranquil town of Franeker to the bustle of a larger city. In consequence of this, his habits and pursuits were in many respects altered. His assiduity and diligence remained the same, but their objects were materially changed.

Amongst the new duties imposed upon him were mathematical lectures. He explained the elements of geometry, and indeed of mathematics in general, in an excellent work, which would have established his fame as a geometer, if it had been written in a language more generally known. In this book, the strictness of demonstration of the ancients is united with practical illustrations, the use of mathematical instruments, and the history of the science. In the last edition of his work, published in 1816, it is striking to find how the venerable author, then far advanced in years, knew and had studied even the most recent publications.

Another work, which he began to publish after he was removed to Amsterdam, is more generally known. The *Positiones Physicae*, as far as they are published, are allowed to rank amongst the best elements of natural philosophy, and have been found by actual experience to belong to the best sources from which the young student could draw his information, on those parts of natural philosophy, and its general principles, as are contained in the first volume and part of the second, which is all that was published. The work itself is on a most extensive plan; and the multifarious avocations which crowded on Van Swinden in Amsterdam, delayed the publication, and made him afterwards abandon all thoughts of completing a work, which would have done the greatest honour to its author, and which even now, unfinished as it is, is celebrated as an excellent specimen of sound reasoning and profound learning.

Some time after he came to Amsterdam, he was elected one of the Directors of the school for the education of seamen, and he did not cease till the last days of his life to promote the object of that charitable institution, with the utmost zeal and care. That zeal prompted him, at the age of more than seventy, in the absence of the teacher of navigation of that school, to proceed thither every day to give the boys their lessons of navigation. With equal ardour he managed the concerns of the school for the blind; and the interests of the Walloon Church, to which he belonged, found in him a ready and zealous promoter.

Neither fortune nor fame were the primary objects of his ambition. But he eagerly endeavoured to render himself useful to his friends, to his country, and to science in general. He never spared any pains, when he could anticipate that his time thus employed would promote the public good; nor did he ever refrain from speaking the truth from a sense of the inconveniences, in which truths unpalatable to those in power usually involve those who bring them to light.

Thus, when in 1795, a census was to take place in Amsterdam for the first time, Van Swinden conducted this business, which then met with considerable opposition.

As chairman of a Committee, to inquire into the state of civil hospitals, medical police, and other institutions respecting salubrity and sanitary measures, at Amsterdam, he rendered most important services to the cause of humanity. By this inquiry a series of abuses and mismanagements, of long standing, were brought to light. Medical and police institutions, which hitherto were deemed excellent, were shown to be really most defective and inadequate. The best means were, at the same time, pointed out for correcting the existing evils. Mr. Van Swinden had then an opportunity of learning, by his own experience, that there is no surer way of exciting envy and hatred, than by bringing to light abuses, in the continuance of which many find their real or pretended interest. But such considerations could not deter Van Swinden from his duty, and he enjoyed even that satisfaction which he wished for. A number of the existing errors were in course of time corrected, many of the plans which he suggested were adopted, and he certainly had the prospect that several more of the salutary institutions which he proposed would be introduced within a few years.

As early as 1787, the present minister of Marine of the Netherlands had instituted a commission for correcting charts, introducing improvements in navigation, and publishing useful books on nautical subjects. Van Swinden was its chairman. In that capacity he caused the first accurate nautical almanack published in Holland to be printed. He wrote an excellent and extensive work on the theory and practice of finding the longitude by lunar observations, and another on the use of nautical instruments. The service thus rendered to his country, by promoting the practice of the best nautical methods, entitles him to the warmest gratitude of his countrymen.

In 1798 the French government wished to have the metrical system of weights and measures discussed, not only by scientific men in France, but also by those of other nations. A scientific congress was consequently assembled in Paris, where such nations as were then at peace with France had their deputies. Van Swinden was one of the two sent from this country, and some of the most eminent men in Europe were thus brought together. Among the leading members was Van Swinden, who took a most active part in all these proceedings. He belonged to the commission, whose members had to repeat separately all the calculations of the measured arc from Dunkirk to Barcelona. He was also one of another commission for determining the metre, and of that for fixing the unit of the new weight. At the close of this investigation, the honour was conferred on Van Swinden of making the general report of the whole, with the necessary explanations. This duty he performed first to the scientific class of the French Institute, and afterwards, in a public sitting of the four classes of that learned body. The elegance, conciseness, and good taste, with which he expressed himself on that occasion, the clearness and accuracy with which he explained the most abstruse parts of the operations, drew forth the most unbounded applause. Frenchmen could not believe that it was possible for a foreigner to express himself in their language with that particular grace, which they consider to belong to themselves, and which they believe to be above the reach of any but their countrymen. The amiable and gentleman-like manners of Van Swinden, so entirely different from what is supposed in France to characterize foreign *savans*, the frankness and ease of his conversation, set off in Paris his vast erudition and deep learning to great advantage. He acquired the friendship and esteem of all who had an opportunity of making his acquaintance, and his stay in Paris made a deeper impression than could otherwise have been well anticipated. With many of the first scientific characters, such as Laplace, Delambre, Thouret, and Fourcroy, he kept up a constant correspondence. Wonderful as it may appear, the eminent qualities displayed by Van Swinden, both as an amiable and as a scientific man, were not forgotten in Paris even after a period of twenty years.

After his return from Paris, he published an elaborate and learned work on the subject of weights and measures, and he greatly contributed by his subsequent writings, tables, and reports to government, to make the new system adopted in the Netherlands.

It was about that period that those who then managed the affairs of this country hoped that some good might arise to the public, if a man who had acquired such a brilliant reputation in Paris, and who was personally acquainted with the principal rulers of the French republic, should be raised to the first office of state. He was consequently called from his studies to the most eminent functions. It was soon found, however, that scientific merit was little calculated to make any durable impression on those who then conducted the affairs of the French republic. Van Swinden himself was soon convinced that politics were not for him, nor he for politics. The firmness of his character, and his constant love of justice and liberty, marked his conduct throughout his brief political career. In that period he had the satisfaction of making government resolve to order a general accurate trigonometrical and astronomical survey of the country; which has since been ably executed by General Krayenhoff. In less than a year one of those political concussions, then so frequent on this side of the channel, drove Mr. Van Swinden from office, and he cheerfully returned to his studies and resumed his wonted occupations. But when Napoleon gave the management of our affairs to his brother Louis, the new king treated Van Swinden with particular favour, and pressed him eagerly to enter again upon a political life. This, however, he constantly and firmly declined. When his country, however, required his services as a scientific man, Van Swinden was sure to be found ready and prepared. At Louis's desire, he framed the plan of the present Royal Institute of the Netherlands. He was its first president, and took a most active part in all its proceedings. He was chairman of a Committee for taking into consideration the hydraulic situation of the country, and for proposing the necessary measures for correcting the existing evils. The plan according to which Louis intended to alter the Universities of Holland was drawn up by Van Swinden, and three other members of the Institute. The subjects of money, coin, and currency, had made a favourite part of his studies, and he was frequently called upon to report to government on matters connected with these important investigations.

When Holland became a part of Napoleon's immense empire, Van Swinden retired as much from the public eye as was practicable. Born in a republic, and strongly attached to liberty and to his country, he could not but deeply lament the many acts of oppression and tyranny which were then daily witnessed. Though in many respects, from early habits and frequent intercourse, rather attached to Frenchmen, he now looked upon them as the oppressors of his country, and as such he sincerely rejoiced at their overthrow in 1813. He then appeared to have taken a new lease of life, and devoted himself with juvenile ardour to whatever service the public good might require of him. In the decline of life he seemed gifted with new strength, and his abilities, instead of decreasing, appeared to acquire fresh energy. The king of the Netherlands honoured him with his confidence and favour on many occasions, and, as a Councillor of State, he faithfully discharged his duty. Respected and beloved by his countrymen, full of activity and life, he was suddenly seized with an illness, which he soon felt to be fatal. With that strength of mind, which sustained him through life, he foretold and awaited its close. In those last moments he displayed the calmness, serenity, and resignation, which become a man and a Christian. He expired on the 9th March, 1823, regretted by his king, and lamented by his widow, his relations and his countrymen, at the age of seventy-six years and nine months. As a social man, Van Swinden was not less amiable than he was respectable in science. He delighted in the company of well-educated females; and young men, who could appreciate his merits, eagerly courted his society. The cheerfulness and hilarity of his countenance was happily tempered by a gravity of expression which had in it nothing pedantic, but always commanded respect. Even Napoleon, who, when he was at Amsterdam, loaded every one who approached him with contempt and abuse, treated Van Swinden with kindness.

When Louis was appointed king of Holland, and was about to make his public entry into Amsterdam, it was required by the Master-General of Ceremonies, that every one who had occasion to address his majesty should previously hand in a copy of his proposed speech, in order to have every thing that was too free struck out or amended. This order Van Swinden, who was then president of the College of Professors, firmly refused to obey. A professor, he said, ought not to suffer himself to be treated like a schoolboy, who hands in a *theme* for correction, and as for himself he would say to the king nothing but what was at once proper and decent. Louis soon after instituted an order of knighthood. Van Swinden of course was among those for whom the distinction was intended, but he peremptorily declared, even to the king himself, that he did not approve of the institution, and could on no account consent to become a member of it. A more trying opportunity, however, of showing the strength of his character was soon afforded to Van Swinden. The school for navigation at Amsterdam had been founded by voluntary subscription, large funds had been left by will to this establishment, both for the education of young mariners and the relief and support of the aged, the disabled, their widows and children. The management of this private property had been given in trust to a certain number of gentlemen, duly elected by the contributors. Napoleon thought proper to take the whole of the property from the hands of the trustees, to send the boys on board of his vessels, and to leave the old men and the women to their fate. The painful task of delivering up the whole to the Prefect maritime, and to the Conseil de Préfecture, devolved on Van Swinden. This he did with an elaborate speech in the French language, in which he pointed out, in the strongest terms, the impolicy, the injustice, and the iniquity of this tyrannical act. Those who knew how matters were managed at that time, trembled at this piece of boldness, and every one expected to see Mr. Van Swinden transported to Paris. But the attention of the rulers of that period was soon strongly engaged elsewhere; and it was Van Swinden's good fortune to witness and celebrate the restoration of an institution which he so much valued. One of the first acts of the present King of the Netherlands was, to re-establish the school of navigation, and to restore to its trustees such property as had been saved from the French.

The following is a list of the principal works of Mr. Van Swinden:—

Dissertatio de Attractione, 1766.
De Causis Errorum in Rebus Philosophicis, 1767.
Cogitationes de Variis Philosophiae Capitibus, 1767.
De Philosophia Newtoniana, 1779.
De Hypothesibus Physicis, quomodo sint e mente Newtoni intelligendae, 1785.
Tentamen Theoriae Mathematicae de Phaenomenis Magneticis. Lugd. Bat. 1772, 4to.
Observations sur le froid rigoureux de Janvier, 1776. Amst. 1777, 8vo.
Recherches sur les aiguilles aimantées et leur variations. Mémoires Présentés à l'Académie des Sciences de Paris, t. 8.
Dissertation sur la Comparaison des Thermomètres, 1778, 8vo.
Observations Météorologiques faites à Franeker pendant l'année 1779. Amst. 1780, 8vo.
Description of the Orrery made by Eise Eisinga in Friesland. Franeker, 1780, 8vo. (Dutch.) A new edition of this work is in the press.
Recueil de Mémoires sur l'Analogie de l'électricité et du Magnétisme. La Haye, 3 vol. 8vo. 1784.
Description du Planétaire de M. Adams, 1786. Plano.
Positiones Physicae, vol. i. and vol. ii. part i. Harderovic. 1786, 8vo.
A Treatise on Finding the Longitude by Lunar Observations. The 1st edition appeared in 1787, and the 6th in 1819. (In Dutch.)
A Treatise on the Use of Hadley's Octant and Sextant, 1788, 8vo. (In Dutch.)
Explanation of the Nautical Almanack, 1789, 8vo. Dutch.
Elements of Geometry, 1790, 8vo. The last edition appeared in 1816.

Report on the Census of Amsterdam, folio, 1795.
On Weights and Measures. Amsterd. 1802, 2 vol. 8vo.
Lectures on Van Laun's Planetarium, Tellurium, and Lunarium. Amsterd. 1803, 8vo.

Besides these works, many papers drawn up by Mr. Van Swinden are printed in the Transactions of those Societies and Academies to which he belonged. In those of the Royal Institute of the Netherlands, there is one in the first volume, on the laws of atmospherical pressure, deduced from observations at Zwanenburg in Holland. In the third volume of the same collection, there is a paper in which Mr. Van Swinden maintains the rights of Huygens, as inventor of the pendulum: of this a translation has been given in Dr. Brewster's Journal.

We may still expect some publication on the invention of the telescope, and that of spectacles, by the same author. Some part of the correspondence of Van Swinden and Sennebier has been lately published in the *Bibliothèque Universelle*, tom. 24, December 1823.

UTRECHT, *June*, 1824.

ART. II.—*Observations on the Pyro-Electricity of Minerals.* By DAVID BREWSTER, LL.D. F.R.S. Lond. and Sec. R.S. Edin.

THE brilliant discoveries of Professor Oersted respecting the magnetical effects of electricity, and the highly important ones of Dr. Seebeck, relative to the thermo-electricity of certain metals, have attached a great degree of interest to the kindred subject of the pyro-electricity of minerals. In so far as we know, however, this circumstance does not seem to have drawn to the last of these classes of phenomena the attention of those eminent philosophers who have so successfully investigated the first; and we are not aware that any later observations have been made on the production of electricity by heat, than those which have been published by the Abbé Haüy.

The name of the philosopher who first observed that the *Tourmaline* was rendered electrical by the simple application of heat, has not been recorded; but there can be little doubt that Lemery was the first author who mentions the circumstance.[*] M. Æpinus of St. Petersburg, was the first person who studied with ardour and success the phenomena which it presented. The experiments of this acute philosopher were published in the Memoirs of the Academy of Berlin for 1756, under the title of *De quibusdam experimentis electricis notabilioribus.* The examination of the subject was continued by Mr. Benjamin Wilson, Dr. Priestley, and Mr. Canton, who discovered the same property in the Brazilian topaz; but it was reserved for the Abbé Haüy to analyse the phenomena of the Tourmaline with the sagacity and patience of a philosopher, to add several new minerals to the short list of pyro-electrical ones, and to detect several interesting relations which had escaped the penetration of those who preceded him in the inquiry. The following is the list of pyro-electrical minerals, as given by Haüy, with the names of those who first noticed their pyro-electrical property.

Tourmaline,	*Lemery.*	Mesotype,	*Haüy.*
Topaz,	*Canton.*	Prehnite,	
Axinite,	*Brard.*	Oxide of Zinc,	
Boracite,	*Haüy.*	Sphene,	

The principal phenomena of pyro-electricity, as observed in these minerals by the Abbé Haüy and preceding writers may be stated as follows:

1. When a prismatic crystal of tourmaline is exposed to an increasing heat, one of its extremities will exhibit vitreous, and the other resinous electricity, as may be easily seen by its action on an electrified needle, and by its power of attracting and repelling light bodies.

2. At a certain degree of heat, the tourmaline will no longer give indications of electricity; but in cooling it again the electricity will reappear, and when its temperature has been reduced to near 32° of Fahrenheit, the electricity again disappears; but upon the application of a greater degree of cold it reappears with opposite characters, the end of the tourmaline which had formerly exhibited resinous electricity, now exhibiting vitreous electricity.[†]

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[*] Mem. Acad. Par. 1719.

[†] This curious fact, announced some years ago as new by the Abbé Haüy, seems to have been discovered by Canton. See *Edinburgh Encyclopædia,* Article ELECTRICITY, vol. viii. p. 458.

3. In most of the crystals which become electrical by heat, the distribution of the electricity resembles the distribution of the magnetic influence in a bar of magnetised steel. The intensity of the pyro-electricity is a maximum at the two poles or extremities of the crystal, and gradually diminishes from these points to the central or neutral point equidistant from both, where it disappears.

4. In the *Boracite*, the pyro-electricity is distributed in a different manner. The primitive form of this mineral is cubical, and each of the four axes joining its solid angles has at its opposite extremities a vitreous and a resinous pole. If the crystal is made to revolve round any of its axes, the vitreous and resinous poles of the other axes will succeed each other alternately. The maximum intensity is very near the extremity of each axis, and the intensity diminishes rapidly in receding from these points.

5. Haüy observed that the *Electric Calamine* was electrical at the ordinary temperature of the atmosphere, and exhibited the inversion of poles which he found in the tourmaline.

6. In studying the phenomena of pyro-electricity, Haüy remarked the curious fact, that while in the great mass of crystals the corresponding summits are similar in the number and disposition of their faces, while in pyro-electrical crystals there is a deviation from this symmetry. In the tourmaline, for example, the vitreous electricity resides in the summit with *six* faces, while the resinous electricity resides in the opposite summit with *three* faces. Hence it is supposed by Haüy, that the two fluids had exerted upon the laws of crystallization opposite influences, which had left their impress upon their crystalline form.

From this brief and general sketch of the labours of Haüy and others in this curious branch of physics, I shall now proceed to give an account of the experiments which I made several years ago on the same subject, and of the results to which they lead. These experiments were made in the years 1817 and 1818; but the publication of them was delayed, in the hope that I should find leisure to extend them to large and well-formed crystals of the various bodies of the mineral kingdom. Having no prospect of accomplishing this task, I commit the subject into the hands of those who have more leisure, and would recommend it as a fertile source of discovery to any young and active natural philosopher, who may have access to a good cabinet of minerals.

1. *On the existence of Pyro-electricity in various Minerals.*

In order to determine the existence of pyro-electricity in minerals where it had little intensity, I employed the thin internal membrane of the *Arundo Phragmites*, which was cut with a sharp instrument into the smallest pieces. These minute fragments were well dried, and the pyro-electricity of any mineral was determined by its power of lifting one or more of these light bodies, after the mineral had been exposed to heat. I used also a delicate needle of brass, the pivot of which moved upon a highly polished cap of garnet, and which was affected by very slight degrees of electricity.

In this way I determined the pyro-electricity of the following minerals:

Scolezite.*
Mesolite.*
Greenland Mesotype.
Calcareous Spar.
Beryl Yellow.
Sulphate of Barytes.
Sulphate of Strontites.
Carbonate of Lead.
Diopside.
Fluor Spar, red and blue.
Diamond.
Yellow Orpiment.
Analcime.
Amethyst.
Quartz Dauphiny.
Idocrase.
Mellite?
Sulphur Native.
Garnet.
Dichroite.

In examining the electricity of the tourmaline, I found that it could be shown in a very satisfactory manner, by means of a thin slice taken from any part of the prism. The experiment is most advantageously performed, when the slice has its surfaces perpendicular to the axis of the prism. When such a slice is placed upon a plate of glass, and the glass heated to the temperature of boiling water, the slice will adhere to the glass so firmly, that even when the glass is above the tourmaline, the latter will adhere to it for six or eight hours. In this way, slices of a very considerable breadth and thickness are capable of supporting their own weight.

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[*] It is probable, that the *Mesotype* of Haüy was one or other of these two minerals.

2. *On the existence of Pyro-electricity in Artificial Crystals.*

It does not appear from any of Haüy's writings, that he even suspected the existence of pyro-electricity in crystals formed by aqueous solution. In subjecting some of these to experiment, I was surprised to find that they possessed this property, and some of them to a considerable degree. The following is a list of those in which I discovered it:

Tartrate of Potash and Soda.
Tartaric Acid.
Oxalate of Ammonia.
Oxymuriate of Potash.
Sulphate of Magnesia and Soda.
———— Ammonia.
———— Iron.
Sulphate of Magnesia.
Prussiate of Potash.
Sugar.
Acetate of Lead.
Carbonate of Potash.
Citric Acid.
Oxymuriate of Mercury.

Among the preceding crystals, the *tartrate of potash and soda*, and the *tartaric acid*, are pyro-electrical in a very considerable degree; but the action of several of the other salts is comparatively feeble.

3. *On the Pyro-electricity of the Powder of Tourmaline.*

Among the curious properties of artificial magnets, none is more remarkable than that which is exhibited, by cutting a piece from one of their extremities. If the piece is taken from the north pole of the magnet, it is itself a regular magnet, with north and south polarity. The very same property was discovered in the tourmaline by Mr. Canton, who found that, if it was broken into two parts when in a state of excitation by heat, each fragment had two opposite poles. Coulomb has ingeniously explained the magnetical fact, by supposing that each particle of the magnet is itself a magnet with opposite polarities; and Haüy has applied the same explanation to the analogous phenomena in the tourmaline.

If we attempt, however, to reduce the magnet into minute portions by any mechanical operation, such as filing, pounding, &c. the particles of steel are found to be deprived of their magnetical qualities, their coercive power being destroyed by the vibrations or concussions which are inseparable from the process of comminution. Analogy would lead us to expect the same result with the tourmaline; and we have no doubt that most philosophers, confiding in the force of recognised analogies, would expect that the powder or dust of pounded tourmaline would not exhibit any pyro-electrical phenomena.

In order to ascertain this point, I pounded a portion of a large opaque tourmaline in a steel mortar, till it was reduced to the finest dust. I then placed the powder upon a plate of glass, from which it slipped off, by inclining the glass, like all other hard powders, without exhibiting any symptoms of cohesion either with the glass or with its own particles. When the glass was heated to the proper temperature, the powder stuck to the glass; and when stirred with any dry substance, it collected in masses, and adhered powerfully to the substance with which it was stirred. This viscidity as it were, or disposition to form clotted masses, diminished with the heat, and at the ordinary temperature of the atmosphere it recovered its usual want of coherence.

Hence it follows, that the tourmaline preserves its pyro-electricity even in the state of the finest dust, and that this dust, when heated, is an universally attractible powder, which adheres to all bodies whatever.

This singular breach of analogy between the distribution of the pyro-electrical and magnetical forces, has an exact counterpart in the distribution of the doubly refracting forces in regularly crystallized bodies, and in plates of glass that have been rapidly cooled from a red heat. If a crystal of calcareous spar is broken into a thousand fragments, the most minute fragment possesses in miniature the same doubly refracting structure as the largest rhomb of that mineral; whereas the plate of glass that has derived its doubly refracting structure from rapid cooling, comports itself exactly like a magnetised bar of steel. Any considerable portion of the glass, *though cut from the positive part,* acquires, upon its being detached from the plate, *both the positive and the negative structure;* but if it is reduced to very minute fragments, or pounded, these fragments lose their doubly refracting structure;—that is, any number of small fragments put together after separation, have not the same doubly refracting force as when they formed part of the plate, the loss of the doubly refracting structure always increasing with the minuteness of the subdivision.

This striking analogy between the effects of the electrical and doubly refracting forces, acquires a new interest from the known relations between the forces of electricity and magnetism, and is well worthy of being pursued into all its recesses. In a paper, which will appear in an early number of this Journal, I shall have occasion to point out many close analogies between the phenomena of magnetism and double refraction, which may help to throw light upon the physical principles which have created so many points of resemblance among the phenomena of the three sciences.

4. *On the Pyro-Electricity of the Powder of Scolezite and Mesolite, when deprived of their water of Crystallization.*

As the powder of Tourmaline, with which the preceding experiments were made, suffered no chemical change by trituration, I was desirous of trying whether or not the pyro-electricity of minerals existed, when the mineral was deprived of any of its ingredients. For this purpose, I converted several crystals of Scolezite and Mesolite into a white powder by heat, so as to deprive them of their water of crystallization, which is now considered as an essential ingredient in any mineral species. When the powder was exposed to heat, upon a plate of glass, it adhered to it like the powder of Tourmaline, and when stirred about by any substance whatever, it collected in masses like new-fallen snow, and adhered to the body that was employed to displace it.

This fact is a very instructive one, and could scarcely have been anticipated. As several minerals differ only in the quantity of their water of crystallization, the powder which was thus pyro-electrical, could not be considered either as Scolezite or Mesolite, but as another substance not recognised in Mineralogy. The pyro-electrical property, therefore, developed by the powder, cannot be regarded as a property of the minerals of which the powder formed a part, but merely as a property of some of their ingredients. In which of the ingredients, or in what combination of them the pyro-electricity resides, may be easily determined by farther experiments.

5. *On the probable influence of Crystallographic composition on the distribution of Electricity in Minerals.*

Although I have not been fortunate enough to meet with any of those crystals which are necessary in the investigation of this branch of the subject, yet there are some facts of sufficient importance to be noticed in such an inquiry.

The Abbé Haüy has particularly mentioned[*] a crystal of topaz, in which the pyro-electricity was distributed in a very remarkable manner. He observed that its two extremities *were both resinous poles*, while the intermediate part gave indications of vitreous electricity. As this phenomenon has been observed only in one mineral, and in one specimen of that mineral, and as it has an exact counterpart in the phenomena of magnetism and of double refraction, it is very probable that the crystal in which it was observed was a compound crystal, in which the two vitreous poles were in contact.

Although the *Scolezite* and *Mesolite* are both composite minerals, yet the faces of composition are parallel to the axis of the prism, and therefore cannot affect the distribution of the electricity which is excited by heat. It is therefore in the topaz, and some of the other pyro-electrical minerals, where we must study the influence of composition.[†]

ALLERLY, *August* 2, 1824.

ART. III.—*Journal of an Excursion through the Himalayah Mountains, from Shipke to the Frontiers of Chinese Tartary.* By ALEXANDER GERARD, Esq. Surveyor to the Board of Commissioners, Lieut. and Adj. 2d Battalion 13th Regt. Native Infantry, on the Bengal Establishment. Communicated by the late Colonel GERARD of Rochsoles. Concluded from page 51.

After crossing the Darboong by a good sango, we marched on the 25th Oct. to Lubrung, a distance of 10½ miles. The road was good, winding very much, and crossing the Roonung Pass, 14,506 feet high, at the top of which the wind was as strong and as cold as it was yesterday at Hungrung Pass. We found a great deal of juniper on the way, the berries of which were large and well tasted, having little bitterness.

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[*] *Traité de Minéralogie,* 2d edit. tome ii. p. 154. We hope that this crystal is in the possession of the Duke of Buckingham, who, we understand has acquired the splendid cabinet of the Abbé Haüy.

[†] Another example of the probable influence of structure on the developement of electricity exists in the Analcime, where the feeble production of electricity by friction, from which Haüy has derived the name of the mineral, is probably owing to its singular mechanical structure. See *Edinburgh Transactions,* vol. x. p. 187, 193.

Lubrung is a large village, on the right bank of the Zong rivulet, a couple of miles from the Sutluj, and 9296 feet above the level of the sea. Opposite to it, and a mile distant, is the populous town of Kanum, where Loktus resides during the winter season. There are two brothers of the names of Buleeram and Busuntram; but they are both generally called Loktus, which word, properly speaking, should be applied to their house, which is a building of great extent.

We marched on the 26th Oct. to Leepe, 6½ miles. The road was bad, lying over sharp rocks. The houses here, as well as at Subrung, are wholly composed of wood. They are small, and in shape exactly resemble cisterns. Leepe consists of an upper and lower division, both of which contain a good many inhabitants. It lies upon the left bank of the Tetee, a large stream, having its source amongst snow twelve or fifteen miles to the north-west. The vineyards here are numerous, and the grapes large and of a delicious flavour.

We marched on the 27th Oct. to Akpa, 10¾ miles. The road was rocky, passing the village of Jaugee, and for the last four miles leading through forests of pine upon the left bank of the Sutluj, from which it was about a mile distant.

Next day we proceeded to Pungee, 10¾ miles. The foot-path was rugged in the extreme, passing great part of the way over fragments of granite, gneiss, and quartz, which appeared to have but recently fallen, and exhibited a heap of gigantic ruins, amidst which we saw many a noble pine lying prostrate, while a few, with their branches broken off, and otherwise disfigured, just barely peeped above the stones. Large portions of rock fall every year, and their ravages are truly dreadful. They sweep every thing along with them, and sometimes stop up the channels of the largest rivers for whole weeks.

From Leepe to this place there is a direct road not exceeding fourteen miles, but we chose to go round by the Sutluj, in order to have a view of the Kylas Peaks.

On the 29th Oct. we marched to Rogee, nine miles. The road was first a very steep descent of 1000 feet to the Mulgoon, a large stream descending at a considerable angle, rushing over rocks with rapid force, and forming a series of cascades. We crossed it by a couple of sangos, the current being divided into two. The ascent from it was fatiguing for a mile; the road then for the next five miles was excellent, being broad, and leading upon soil through woods of pine, the trees of which attain a large size; but not quite equal to those near Brooang, one of which measured 33 feet in circumference. The last 1½ mile was of an extraordinary nature, along the brink of a tremendous precipice, and often upon unsteady scaffolding that has been constructed with very great labour. This continues for several hundred yards together, and is formed of spars driven into the crevices of perpendicular faces of rock, with the other ends resting upon trees or posts, and boards across. Now and then you meet with a rude stair of wood and stone, which must have required much trouble to erect. The rocks project above the path, and the traveller is frequently obliged to stop in order to avoid them, whilst at the same time he must pay equal attention to his footing.

Part of the road was destroyed last rainy season; and had not upwards of twenty people been early sent off to repair it, we should have been forced to go by the Sutluj, which is nearly a whole march round. By the time that we arrived at the place that had given way, they had made several clumsy wooden ladders, which answered our purpose tolerably well.

The mountains latterly on either side of the river are craggy, abrupt, and rent in every direction, almost destitute of soil, and thinly wooded; but in the vicinity of Kushbeer, which we passed half way, the ground slopes gradually to the Sutluj at some distance, and is thickly studded with hamlets, and adorned with vineyards.

At Rogee, we saw many orchards containing apples of an excellent kind, nearly as large as those brought from Kabool, which they far excel in flavour.

On the 30th Oct. we proceeded to Meeroo, 8½ miles. The road was very uneven, upon angular pieces of quartz, gneiss, and granite, and often skirting a precipice about a mile from the Sutluj, here called Sumudrung. The rocks on our right hand were of the same cracked appearance as yesterday, frequently overhanging the foot-path, and menacing destruction. To the left, towards the river, the declivity is more gentle, and generally clothed with pines, unless where they have been buried amongst rocks dislodged from above.

Meeroo is situated in the district of Rasgramee, and is 8550 feet high. Besides the subdivisions of Koonawur already noticed, there are three more; Uthara-beesht, on the southern bank of the Sutluj, to the westward of Brooang; Pundra-beesht, opposite to it on the north side of the river; and Wangpo, containing only seven small villages, to the north-west of Meeroo, on the banks of a considerable mountain torrent.

On the 31st Oct. we marched 7¾ miles, and encamped near a cave, close on the right bank of the Sutluj. The pathway was indifferent, ascending and descending alternately; and passing the village of Chegaon, or Cholang, pleasantly situated near Astuam, five miles from Meeroo. Half a mile on this side of it, the road led through an arch of two stupendous rocks of granite, which meet at an angle.

On the 1st Nov. we marched to Nachar, eight miles. The way was rough for four miles to the Wangpo, a large mountain torrent, that rushes down a steep declivity, forming many waterfalls in its course, and dashes against the huge masses of rock in its bed with a noise like thunder, throwing up the spray to an astonishing height. We crossed it by a good sango, and proceeded half a mile upon level ground to Wangtoo Jhoola, a rope bridge over the Sútluj. It consists of five or six cables close together, upon which is laid half a hollow fir-tree about two feet long, with pegs driven through it, to prevent its coming off. From this hangs a loop of three or four ropes, in which the passenger takes his seat. It is pulled across by two pieces of rotten twine, which, from constantly breaking, render this a tedious mode of transporting baggage. The conveyance is a pretty safe one, but greatly alarming to a novice; for the Jhoola (or rope bridge) is elevated twenty feet above the stream, which runs with great rapidity and a deafening noise.

Near this are the remains of a wooden bridge, such as described in Captain Turner's narrative, that was destroyed on the Gorkah invasion of Busehur.

We found the breadth of the Sutluj at the bridge 88 feet, and the height of its bed 5200 feet. In some parts it is scarcely 50 feet broad; and it was in attempting to swim across at a narrow place that one of my servants was drowned here last year. After much delay we got every thing across without an accident, and ascended for 3½ miles to Nachar, where there are a few grapes, which seldom ripen. The cold does not depend near so much upon the absolute height of the place as its elevation above the bed of a river; for vines come to maturity upon the banks of large streams 9500 feet from the level of the sea; and Nachar does not exceed 7000 feet in height.

Next day we proceeded eight miles to Turanda, in Utharabeesht, and three miles from the western limit of Koonawur. This day's march was beautiful for the first 3½ miles, upon soil and through shady groves of lofty pines from twenty to twenty-seven feet in circumference. The road then was a rocky descent of 1½ mile to the Syldung, a rapid torrent, dashing over large stones, and coming from the Himalaya mountains to the southward. We crossed it and another stream a little above their union by a couple of bad sangos, and ascended from its bed by a rocky footpath, winding amongst extensive forests of oak, yew, pine, and horse chesnut, to Camp.

On the 3d Nov. we were detained by a heavy fall of snow and hail, which lay around us in large quantities many hundred feet below the village. Had this shower come on a few days ago, we should have been prevented from crossing Soongnum, which, together with those above 13,000 feet, are blocked up for four months in winter.

Our next day's march was to Soorahun, thirteen miles. It took us almost the whole day to perform the journey; for the path, which is at all times dangerous, from lying near a precipice, upon smooth stones great part of the way, by the late shower of snow, now frozen hard, had become so slippery that we could get on very slowly.

We crossed four streams of some size, besides many smaller ones. They are all rapid, but of no great depth.

The mountains near this are heavily wooded to their summits; the cultivation increases at every step; the villages are more thickly scattered.

Soorahun is 7248 feet above the level of the sea, and is situated in Dusow, one of the large divisions of Busehur. It is the summer residence of the Rajah, and most of his Wuzeers, who stay here six or seven months in the year, to avoid the great heats at Rampoor. It contains several good houses, and a temple attended by Brahmins.

On the 5th Nov. we marched to Dhar, 9½ miles. The road was bad crossing the Munglad, a rapid torrent, by a rotten sango, consisting of two fir-trees about a foot apart, with small twigs, and slates laid across. One of the spars is much lower than the other, and the bridge is both unsteady and unsafe. The descent to the stream was at such a great angle, that we frequently slid many feet at a time. The ascent was equally bad, lying upon pure mica, shining with a bright lustre, and extremely slippery.

Next day we marched to Rampoor, distant 8¼ miles, the road was sometimes rugged, but more commonly even. Part of the way it was a complete swamp, lying through rice fields, intersected by many rills.

Rampoor is situated on the left bank of the Sutroodra, or Sutluj. Although the capital of Busehur, it is not so populous as might be expected. There are several fairs here during the year, to which the Koonawurees bring blankets of various sorts, and coarse shawls, wool, raisins, salt, borax, and chourees, and exchange them for wheat, tobacco, goorh,* swords, &c. The houses may be about 100 in number. They are large, well built, and covered with thick slates of a brownish colour, which form very heavy roofs. Upon a few of the houses the slates are cut into oblongs, and laid regularly, which give them a neat appearance; but by far the greater number are of all shapes and sizes, put on without any regard to order. Under the rajah's palace, a handsome edifice at the northern angle of the town, there is a rope bridge similar to the one at Wangtoo, across the Sutluj, leading to Kooloo. The breadth of the river here is 211 feet, and the Shoola is elevated thirty feet above the stream, which, in the rainy season, comes within four feet of it. In December and January, when the river is at its lowest, people sometimes cross upon inflated skins.

We found the bed of the Sutluj, by barometrical observations, 3260 feet above the level of the sea.

The site of Rampoor is low, and much confined, and one of the worst that could have been fixed upon. Being encircled by high mountains, subtending an angle of between twenty and thirty degrees, a breath of wind can scarcely ever reach it. There is little soil, and no wood upon the surrounding hills; and large portions of naked rock appear on every side of the town, which, being once heated, retain their warmth for a long time, so that in summer the nights are not more cool than the days, and from there being no circulation of the air, the place for several months is like an oven.

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* *Goorh*, coarse sugar.

On the 7th Nov. we marched to Nirt, upon the left bank of the river. The distance is 12¼ miles, and the road for the first 4¼ to the Nonguree, a large rivulet coming from the eastward, consisted of short ascents and descents, sometimes rocky. We crossed it by an excellent high sango with a railing; and the rest of the way was quite plain, lying near the Sutluj.

The extreme height of the bed of the river opposite to our camp is 2912 feet, and as this is the last place where we had an opportunity of measuring it, I shall now endeavour to give some idea of the probable height of Mansurowur Lake, from or near which it is said to take its rise. The Sutluj has a variety of names, being called Sutlooj, Sutroodra, Sumudrung, Sampoo, Langzhing-Kampa, Muksung, and Zung-Tee, in different parts of its course. Sutroodra is the name most commonly used, by which it is known from its source to the plains. In the Koonawur language, the words Sumudrung, Sampoo, Kampa, Muksung, and Tee, all signify river. Zung means gold, and with the addition of Tee, is applied to the stream, at a sandy place near Murung, where gold dust is found. By the accounts of many people who have travelled along its bank to its source, it issues from lake Rawun Rud, called also Ruwathud and Lanka, which was confidently said by every body I saw that had been there to communicate with Mansurowur, although Mr. Moorcroft could not discover the outlet of the latter lake. The circuit of Rawun Rud was represented to be no less than seven days journey; but it is most likely both lakes were included.

From Nirt to Sudum Sango, under Numgeea, the horizontal distance by the map is 72 miles, although by the road it is almost 140. The difference of the altitude of the bed of the river in this space is about 5690 feet, which gives the fall of the river near 80 feet per mile in a direct line. From Numgeea to Mansurowur, which is placed agreeable to Major Hearsey's intelligence I fancy not far from the truth, as its distance from Shipke agrees well with the accounts I received, the horizontal distance is about 167 miles. If, therefore, only 35 feet be allowed for the fall of the river per mile, from Numgeea upwards, it will give the extreme height of Mansurowur, or Mapang Lake, above 14,000 feet; and I am inclined to think this estimate rather under the truth than otherwise, for Mansurowur is unquestionably very elevated, from the circumstance of four large rivers, and perhaps five, taking their rise in that quarter.

1st, The Sutluj issuing from the lake itself.

2d, The Sind, or Sing-Ke-Choo, known likewise by the name of Sind-Ke-Kampa, has its source north-east of Mansurowur. It is described as being a very large river, and the principal branch of the Indus, being frequently named Attuk even near Garoo, three marches to the eastward of which it passes, running close south of the capital of Ludak, and three or four days journey to the northward of the valley of Kashmeer.

3d, The Tamjoo-Kampa springs from the mountains east of Mapang, and at first flows towards the eastward.

4th, The Manja-Choo rises to the south of Mansurowur, and runs south-east. The latter two rivers I conclude to be the Burumpooter and Gogra.

I likewise heard of a fifth river, (but only from the accounts of one person,) said to be crossed eight or ten marches east-north-east of Garoo. Its source is reckoned near Mapang, and it runs north-east, so that it is perhaps one of the great Chinese rivers.

On the 8th Nov. we marched 8¾ miles, to Kotgoor, where there is a cantonment for two companies of the 1st Museeree Battalion. The road at the beginning of this day's march lay close upon the left bank of the Sutluj, and there was a steep ascent of 3500 feet, latterly winding amongst beautiful woods of oak, pine, and yew.

On the 10th we proceeded 7¼ miles, to Hutoo, in order to make some astronomical observations, and get the bearings and elevations of the surrounding objects. The ascent from Kotgoor is not less than 4000 feet. The road at first was good, but afterwards became steep and rugged. Hutoo consists of two small forts, upon the top of a hill, 10,600 feet above the level of the sea, connected on the north-east with the snowy mountains. The prospect from this spot is very extensive, upwards of fifty forts, with from four to six towers each, may be distinctly counted in the Rajahships of Kooloo, Sooked, and Mundee north-west of the Sutluj. Beyond these are seen high mountains, covered with snow. To the north-east and east appears the great Himalaya chain, extending until it is lost in the horizon, whilst to the south and south-west, the hills decrease in height to the plains, which are clearly distinguished at a distance.

We were detained here until the 16th, for we were involved in mist for several days, during which time we could not see half a mile on any side. The thermometer did not get above 34° in a house, with a blazing fire for two snowy days, and at sunrise it was 28°; but, when the clouds cleared away, it rose to 40° and 41° at noon. After completing our observations, we returned, on the 16th, to Kotgoor, where we stayed a couple of days, and on the 19th marched to Jeemoo, 9¼ miles. The road, for about four miles, was generally good, passing many villages, and lying upon the face of a left-hand range, through dark forests of various sorts of trees, to a small stream, from whence there was a very steep ascent of 2400 feet, through a thicket, to Nagkanda Pass, 9000 feet high. We here found a great many hazel trees; but all the nuts were rotten. From the Pass to Camp we had a moderate descent of three miles, on the slope of a range that lay upon our right.

On the 20th we marched to Muteeana, nine miles. The road for near six miles was good, upon the right bank of a rivulet, and crossed by many brooks, to Mandunee, where there is a handsome temple, built in the Chinese style. After leaving it, we crossed the Kuljehur, a stream coming from the northward, that divides Keoonthul from Koomarsaeen, two small states under chiefs called Ranas. The descent to the Kuljehur was steep, and the ascent to Camp equally so, each about 1000 feet. The mountains we passed are wooded with pines and oaks in the valleys, but above produce little except grass.

We marched to Bunee on the 21st Nov. 14¾ miles. The road consisted of easy ascents and descents, near the top of a range, upon soil, and through a very highly cultivated country, abounding with villages.

On the 22d we proceeded to Semla, 11 miles, and next day made a forced march of 22½ miles, to Soobathoo. The latter part of the road has already been described.

Throughout the above tour, the road was surveyed with some care, and a number of peaks were fixed trigonometrically, which agree well together. We were extremely lucky in having clear weather, and always managed to get two, but most commonly four, meridian altitudes of stars, contained in Mr. Pond's catalogue, at every halting place except one.

We had two sextants, and a Troughton's reflecting circle, having a stand, with the last of which instruments the latitudes were usually observed. We carried no less than fourteen excellent barometer tubes with us, only two of which returned in safety. Before setting out, they were all found to stand at the same point; and the height was always measured from the surface of the mercury. At every Camp we tried the height of the boiling point, with a good thermometer, which never gave the altitude above 200 feet different from the barometer. The largest theodolite was constructed by Troughton, and graduated both vertically and horizontally, to twenty seconds; the elevations of most mountains, subtending small angles, were taken with it, and those above 10° were observed either with the sextant or circle, and artificial horizon.

The height of the colossal Tuzheegung, whose summit is almost 22,500 feet above the level of the sea, was determined by angles of elevation between 4° and 24°, taken at eight different stations, varying from 9000 to 19000 feet in height, and from two to about thirty miles distant from it, allowing one-fifteenth for terrestrial refraction; and the extreme difference between any two of the observations does not amount to 250 feet. The Kylas peaks, besides many others, were calculated from many stations at various distances, and none of them differ above 500 feet from one another. The next highest peak to the Tuzheegung that we saw is above 21,000 feet. It was seen from Hutoo, 53 miles distant, under an angle of 1° 47′, and its altitude, deduced from this, comes within 200 feet of what the observation at Rogee gives it, when the distance was eight miles, and the elevation 15°.

ART. IV.—*List of the Localities of some of the rarer Scottish Minerals.* By JOHN MACCULLOCH, M.D. F.R.S. F.L.S. and M.G.S. Chemist to the Board of Ordnance, and Professor of Chemistry in Addiscombe College. Communicated by the Author.

As no mineralogist has yet thought proper to draw up a list of such minerals as are found in our own country, the following contribution is offered towards this object. To know what species we possess, out of the extensive list of minerals now ascertained, is not only a subject of rational curiosity, but is of use to the student, by engaging his attention, and by exciting his industry and observation during his investigations. To find in its native place the mineral he has only seen in cabinets, is an event always highly interesting; while it is no less useful in making him acquainted with all their obscurer modifications or varieties, which, from that very cause, their being less perfect, are rarely admitted into collections. A quick eye for the discrimination of minerals in their obscurer forms, or when intermixed with other substances, can indeed scarcely be obtained without practice of this nature; while it also accustoms the young observer to keep his attention alive to the objects around him, and thus, not only to find substances already known, but to be the discoverer of new minerals.

He will thus also learn, not to trust to the mere physiognomy of minerals in his investigations, but to acquire that fundamental knowledge of their real distinctions, without which he will frequently find himself at a loss in recognising any particular substance under a different aspect from that with which alone he has been familiar. He will not be long in discovering, in his attempts to investigate or name minerals in their native place, that the merely empirical knowledge of their best characterised appearances which he has acquired in cabinets, will not go far in ascertaining them in nature.

The completion of a geographical list of native minerals, may thus eventually add, not only to the amusement, but to the instruction of the student. It is true, that in the systems of mineralogy drawn up by our several native writers, many such localities have been recorded. But even those which are generally known, are not all to be found in any one of these works, nor can they be extracted without labour; while these writers, with all their industry, have not always been able to obtain the yet unpublished knowledge, of this nature, which is dispersed among many individuals.

There are many persons whom this list may probably induce to transmit to this Journal, such localities of this nature as they are acquainted with. When thus rendered more perfect, it will be of use, not merely for the purposes already suggested, but will form a fund on which the future writers of mineralogical systems may draw with little labour.

I have here only pretended to give the places and names of such minerals as I have myself found; some of which, it is true, have been long known to many other persons as indigenous to Scotland. There are many others in that country which ought to be recorded; but that task is best left to those who have seen them in their native places.

I would willingly have described the exact spots of those which I have named in a more particular manner, but that could not have been done without prolonging this paper to an inconvenient length, nor even then could a mineralogist have been directed to them with unerring precision.

The minerals of most common occurrence are not noticed, for the most obvious reasons; but all the varieties of such of these as are rare, or in any way interesting, are mentioned.

If such a list shall hereafter be rendered tolerably complete in the way here suggested, it might easily be reprinted in a condensed form, as a manual to the travelling mineralogist.

QUARTZ.

Of this very common mineral, it is only necessary to notice the varieties which are rare, and which more particularly comprise those that present peculiarities of colour.

Foetid.—At Pol Ewe and Loch Greinord, on the western coast of Scotland. This is found in gneiss, forming veins, and the smell often resembles that of putrid sea weed. It is sensible only on friction, and diminishes when the specimens have been so long kept as to lose their water.

Green. Coloured by chlorite. In Bute; on the shore of

Cowal; on the south-eastern shore of Jura, and on the north-western of Isla, opposite. This quartz forms veins in chlorite schist, and is always accompanied by common chlorite. Some of the varieties are so dark as to be nearly black. It has been mistaken for prase, from which it is essentially different. The following variety is the prase of the Germans.

Green. Coloured by green actinolite. Prase. I have found this variety only once, and it was in a very limited quantity even there. This was in a small island within, and not far from the entrance of Loch Hourn. As it is too insignificant to have a name in the map, I cannot direct mineralogists to it more accurately. This quartz is in veins, traversing actinolite schist; and, according to the quantity of the intermixed colouring matter, it varies from a very light to the usual dark green of this mineral.

Green. Coloured by the green earth of the trap rocks. In Rum, in Scuir-more, together with the heliotrope of that place. In Glen Farg, and in the hill of Kinnoul. It also occurs in Ayrshire; and generally, in this case, it is intermixed with other chalcedonies and agates.

Green. Coloured by an intermixture of green compact felspar. In Rona, (East) at Pol Ewe, and on various parts of the western coast of Ross-shire.

Pink. Opaque, and pink or flesh-coloured. Common quartz, coloured by an unknown ingredient. In Lewis, from gneiss.

Pink. Opalescent, or rather milky. In Coll; in Aberdeenshire, on the Buck of Cabrach. The latter specimens are nearly transparent. In Loch Maddy in North Uist.

Brown red. Transparent. Apparently coloured by iron. On the western coast of Sutherland, in veins traversing gneiss, between Loch Inver and the Ru Storr. In East Rona; in the Angus hills.

Brown red. Milky or chalcedonic quartz. At Gerloch in Ross-shire, in gneiss.

Purple or *lilac.* Opake. In Shetland, near Selie-voe, in gneiss.

Violet blue. Pale; opalescent. In Loch Maddy, in North Uist, in gneiss.

Purple. Crystallized; amethyst. In trap in the hill of Kinnoul, and elsewhere; found in the centre of agate nodules. In the hills of Mar, in granite.

Grey. Blue or French grey. Opake. In Glen Tilt, in veins in gneiss; and in Aberdeenshire.

Grey. Blackish. Common quartz, irregularly transparent. In various parts of Aberdeenshire, and in Shetland.

Grey. Blackish. Chalcedonic quartz. In Gerloch, in Ross-shire; on Ben Lair in the same county, in gneiss. The colour varies from very pale to very dark blackish grey, and the specimens are also exceedingly various in their degrees of transparency.

Black. Common transparent quartz, apparently coloured by an intermixture of hornblende, just as it is sometimes coloured green by actinolite. The fine splinters are translucent. In Ben Lair, in Ross-shire, in hornblende schist; but it seems very rare.

Brown. Transparent quartz. The colour varies in intensity, but the colouring ingredient is not known. It is discharged by a moderate heat. It is found crystallized, notedly in Cairngorm, in granite. In Arran, and in Benna-Chie, in granite. In St. Kilda, in that syenite which is connected with augite rock and greenstone. At Killin, perfectly transparent, but uncrystallized; in nodules in chlorite schist. In North Rona, in granite veins, uncrystallized.

Yellow. A brownish yellow crystal occurs in the hills of Mar. Yellow quartz, imperfectly transparent and full of fissures, is not uncommon in the Perthshire hills, but it seems in general to have been coloured somewhat recently, by having admitted a stain from the rust of iron.

Colourless or greenish. White amethyst. In Fife, and in the hill of Kinnoul.

Colourless. Transparent. The crystallized kind is too common to deserve notice; but as it is rarely transparent when in veins and nodules, I may here remark that it occurs in this manner in the chlorite schist, at the south-eastern extremity of Jura, and the north-eastern of Isla.

Granular white quartz, resembling refined sugar, is found in Harris, and in Ben Lair, in veins traversing gneiss. There is here also found a singular variety, in which a purely hyaline quartz passes gradually into this snow-white and finely granular kind. It is unnecessary to point out the localities of the other varieties, which abound everywhere.

FELSPAR.

As in the case of quartz, I shall here only notice the most remarkable and most rare varieties of this mineral. I may remark, generally, that they are principally found in those districts which consist of gneiss, and are almost always integrant portions of the granite veins with which that rock abounds.

Pure white. Opake. At Hillswick, in Shetland, intermixed with actinolite, and very splendent. At Cape Wrath, in granite veins. In Coll, Harris, and in Arisaik.

White. Translucent where thin; splendent and reflecting much pearly light from the interior. This very beautiful variety occurs in Harris, on the southern side of Roneval The ordinary white varieties, under many different aspects, are too common to require particular notice.

White. Crystallized. In Cairn Lia, one of the summits of Ben-y-gloe, in micaceous schist. In Aberdeenshire, not very uncommon; particularly in the granite of Bennachie.

Flesh-coloured. A brownish flesh-coloured variety, characterized by a high degree of transparency, and pearly lustre in the thin fragments, occurs in east Rona. A very beautiful yellowish flesh-coloured and similarly splendent variety abounds in North Rona. This colour is here distinguished for its peculiar purity and beauty, compared to the ordinary colours of felspar.

Blue-grey. This variety also abounds in North Rona, but I have never observed it elsewhere.

Brick-red. Very bright. This occurs in Lewis, in Ardgower, and in Shetland, but is rare. Reds declining from this in brightness and purity, are too common to require notice.

Purple-brown. In Eriska and Fudia, and less perfect in Coll.

Brownish grey. Inclining to purple in some instances, and resembling that of a Labrador, but not iridescent. In Sky, in veins in hypersthene rock, and in Rum. In Aberdeenshire.

Glassy Felspar. In the basalts and clay-stones of the western islands in general. Very large in the clay-stones of Blaven in Sky.

COMPACT FELSPAR.

Bright green. In Iona, and in Tirey, in gneiss. Very abundant in the same rock at Loch Greinord, and generally on the western coast of Ross-shire. In different parts of Inverness-shire and Aberdeenshire, but more rare. This mineral has hitherto been mistaken for quartz and for epidote.

Lead-grey. In Loch Maree, in Ross-shire.

Brown Purple. At Pol Ewe in Ross-shire. These two resemble precisely the compact felspars of Sweden.

White. In Iona. In West Rona, in North Uist. This is an extremely beautiful substance, and it also occurs in Sweden; but I have never yet seen specimens from any other place or country.

HORNBLENDE.

Crystallized in East Rona; also in Ben Lair.

Platy and *splendent*. Dark green, resembling diallage; in Coll.

Fine fibrous. Resembling black satin, in Perthshire. In general it is too common, under its ordinary forms, to require further notice here.

Fine fibrous radiated. In clay-slate at Boharm, in Banffshire. This is a very singular and beautiful variety; putting on many remarkable forms, and, as far as I know, peculiar to this spot.

Pargasite. In Tirey, in white marble. The characters are extremely well marked.

ACTINOLITE.

Intermixed in large crystals. Either alone or imbedded in talc. In Glen Elg near Eilan Reoch. In Isle Oransa in Sky. At Hillswick in Shetland.

Fibrous. Continuously straight, curved, or undulated. In Glen Elg, and in Aberdeenshire.

Schistose. In Glen Elg; very finely laminar. In Sutherland, in Shetland, in Nether Lorn.

Short fibrous entangled. In Glen Elg. In Isle Oransa. Near Fedaland in Shetland.

Flat Platy, entangled. In Isle Oransa.

Finely stellated, entangled. Near Fedaland in Shetland; near Blair in Atholl.

Nearly pulverulent, and *very pale.* In Shetland, near Burra Voe. The stellated and this last are extremely beautiful and singular minerals, to which I have seen no resemblances among foreign specimens.

Nearly white. Crystallized entangled. Near Handa in Sutherland. In this case there is a near approximation to tremolite; and it may even be doubted whether there are any essential differences.

TREMOLITE.

In large crystals openly entangled and independent. In Tirey; from primary limestone.

In large crystals imbedded. In Glen Tilt.

Large fibrous, radiated or straight. In Glen Tilt. Of very large dimensions.

Flat bladed, radiated. In Cairn Lia (Ben Gloe), in Unst (Shetland.)

Fine fibrous, radiated or straight. In Glen Tilt, at Portsoy, in serpentine; at Dunkeld, in clay-slate.

Fibrous, asbestiform or silky. In white primary limestone. In Glen Elg.

Small stellated, imbedded. In Glen Tilt.

In imbedded and radiated spheres. In Glen Tilt.

In short fibrous crystals, compacted into a solid mass. In Glen Tilt. This variety sometimes appears to be almost granular. The specimens of tremolite, in this locality, all occur in primary limestone, and are very splendid; and most of the several varieties here named are so rare that I have seen no parallel to them in foreign collections. It is remarkable, that in Tirey, crystals of tremolite and of Sahlite are so confounded, that a single crystal sometimes contains both substances, as if there was a transition between the two minerals.

HELIOTROPE.

Chalcedony, coloured by green earth. In Scuir-more in Rum. In nodules, in the trap conglomerates of Kerrera. In the hill of Kinnoul; in Ayrshire; in Mull, under Gribon. On the beach at St. Andrews, loose.

DIALLAGE.

In Unst and Fetlar, in serpentine and in diallage rock. In Balta, in diallage rock. In Ayrshire, in serpentine.

STAUROTIDE.

In Bixeter Voe, Shetland, in micaceous schist. The crystals here are as large as those of Britanny.

HOLLOW SPAR.

In micaceous schist near Balahulish. This mineral occurs abundantly in Skiddaw, in clay-slate, as is well known; but I have never found it in Scotland, except in the above-mentioned place.

APATITE.

In Ross-shire, near Bonar Bridge, in gneiss and granite. In trap, (claystone) in Rum.

HYPERSTHENE.

In Sky, and in Ardnamurchan, in hypersthene rock. In Rum, in veins in augite rock. It appears also to have been found loose in Banffshire; but its native place has not even been conjectured.

STAUROLITE.

At Strontian, in a granite and metalliferous vein. In the Kilpatrick hills, in trap. It is not crossed or twined in either of these places; but the crystals are of great magnitude.

PINITE.

In Ben Gloe and in Forfarshire, in porphyritic veins. In Argyllshire, in massive porphyry. In these cases it forms an abundant ingredient in the rock, and has been mistaken for mica.

SPODUMENE.

In Glen Elg, in granite. In this case it is an ingredient of the rock, generally diffused with the felspar, mica, and quartz.

CYANITE.

In Shetland, at Hillswick, and in the southern promontory of Mainland, in mica slate. In Glen Tilt, in quartz. At Boharm in Banffshire, in clay slate. This last is the locality where the mineral was first found; whence it was sent to Saussure, and by him named Sappare,—a term corrupted from Sapphire by the person who transmitted it.

GARNET PRECIOUS.

At Strontian and in Ardgower, in granite and gneiss. In Harris, in gneiss. At Ely in Fife, loose. That of Strontian resembles the Hungarian in colour. That of Harris resembles the Greenland and the Indian garnets.

TOPAZ.

Blue, white, and brown. In decomposed granite in Braemar, loose. Single crystals weighing fifteen ounces have been found. A fragment in my possession belongs to a crystal which must have weighed eight pounds when entire. The blue and brown are sometimes united in one crystal.

BERYL.

In the same situations and place. The topaz is tolerably abundant; but this is rare, and the crystals imperfect generally, as if carious or corroded.

CHLORITE CRYSTALLIZED.

In Cairn Lia, in micaceous schist. In Jura, in chlorite schist. In Bute. At Dunkeld. The crystals of Cairn Lia are very large and perfect, being compounded hexagonal prisms terminated by pyramids.

FLUOR SPAR.

In Sutherland and Aberdeenshire, in gneiss and granite. That of Sutherland is purple. That of Aberdeenshire is most commonly green and white, and the green colour is discharged by exposure to air. At Strontian, in a granite and metalliferous vein. In Ayrshire, and in Papa Stour in Shetland, in claystone amygdaloid. This last situation is very rare.

CHLOROPHÆITE.

In Rum, in claystone and basalt; and near Burntisland in Fife. I found this mineral first in 1810. It varies in lustre in these two localities, the former being transparent when first found.

CONITE.

In Glen Farg, in Mull, in Sky, and in the Kilpatrick Hills, in amygdaloidal trap. These are the only places in which I have yet observed this new mineral.

PREHNITE.

In gneiss, in Yell, Shetland. In traps in the following situations: At Bishoptown, near Paisley. In the Kilpatrick

Hills. In Glen Farg. In Mull, Sky, Arran, and Rasay. In Edinburgh castle rock, and in Salisbury Craig. In Dumbarton castle rock.

LAUMONITE.

In Sky, near Loch Brittle. In the Kilpatrick Hills.

APOPHYLLITE.

In Sky, near Loch Brittle. In the Kilpatrick Hills.

STILBITE.

In Sky. In the Kilpatrick Hills, red. Near Stonehaven. In Fife. In the Shiant Isles. In Staffa and Canna. In all these places in traps. In Arran in granite. At Strontian in a granite vein. In Kerrera, red, in argillaceous schist; being the only instance, I believe, of that association.

COMPTONITE.

If this be a new mineral, it is the supposed stilbite of Strontian above mentioned.

ANALCIME.

In Sky, Canna, Staffa, Ulva, and Mull. In the Kilpatrick Hills. In Edinburgh castle rock, and in Salisbury Craig. In Dumbarton castle rock. In Sky it is often transparent. In the Kilpatrick Hills it passes by a complete transition into prehnite. The primitive form occurs at Talisker, in Sky.

MESOTYPE.

In Glen Farg. In Sky. In Arran, the Shiant Isles, Staffa, and Ayrshire.

NADELSTEIN.

In the Kilpatrick Hills. In Sky. In Arran. The radiated variety, called natrolite, occurs in Staffa, and near Burntisland in Fife. The nadelstein of Talisker and Dunvegan in Sky, often resembles the finest cotton, or flaw silk, and is so light as to float in water.

CHABASITE.

In Sky, at the Stoor, and at Talisker, in traps.

WAVELLITE.

In the Shiant Isles, in an indurated shale or flinty slate of the secondary class, which belongs to the coal strata of the Western Islands, and is indurated by the vicinity of trap.

OLIVIN.

This is rare in Scotland. In Sky, in trap, near Loch Brittle; forming half the mass of the rock.

ADULARIA.

In granite in Arran. In granitic veins in micaceous schist in Cairn Lia. This mineral is very rare even in those localities.

AUGITE.

In Rum, in trap rocks, with felspar; very remarkable, and of a very large size. In St. Kilda, Arran, Sky, &c. in a similar manner. In Tirey it is found in white primary limestone, and sometimes regularly crystallized.

SAHLITE.

In Tirey, often crystallized, and of various colours, forming very beautiful specimens. In Harris equally or more various, and often of a dark brown. In Glen Elg, silvery white. In Rannoch, pale green. In Glen Tilt, white, massive, in large beds; where it is associated with tremolite, as it also is in Tirey; decomposing also into a very tenacious and unctuous clay.

ANDALUSITE.

In Aberdeenshire, in granite.

CALCAREOUS SPAR.

Green. Coloured by green earth, of a light green. In Rum. Of a dark green, by common chlorite in Bute. Those varieties are extremely singular and rare.

Yellow. Crystallized in the inverse rhomb. In the primitive rhomb. In Sky also. The varieties found at Strontian are so well known that I need not enumerate them.

HYDRATE OF MAGNESIA.

In Unst in Shetland, and in Balta. Found in serpentine and in talc schist.

OXYDULOUS IRON.

Octahedral. In hypersthene rock in Sky. In talc and in chlorite at Fillswick in Shetland. In chlorite schist in Bute.

Micaceous. In veins or nests, in clay slate, at Dunkeld. In dispersed grains, in gneiss and granite, in Shetland. In the same manner in a compact grey *(old red)* sandstone.

Specular-volcanic. In trap veins in Perthshire. This is crystallized in prolonged hexagonal plates, and resembles that of Vesuvius.

BOG IRON ORE.

The resinous variety. In Foula, Shetland. This variety is not common, and resembles, in its lustre and fracture, those Hungarian jaspers which have been improperly called pitchstone.

OXYDE OF CHROME.

In Unst, in chromate of iron. This new mineral is the pure oxyde of chrome, not the mineral called by this name in Lucas's system; and is either compact or pulverulent, being sometimes green, at others yellow.

GOLD.

In Sutherland, near Helmsdale. In Perthshire, in the sands of the Tay.

SULPHURET OF MOLYBDENA.

In Glen Elg.

BLACK LEAD.

In Ayrshire, at Cumnock. In Glen Elg. In Strathpeffer. In Shetland.

I have not here noticed the lead ores of the Lead Hills, or the other metallic minerals of that spot, as they are generally known, and as their locality is equally notorious.

I may add to this enumeration of the rarer earthy minerals of Scotland, that I am in possession of two new minerals, appertaining to the family of *Zeolites*, respecting the analysis and distinguishing characters of which I have not yet so far satisfied myself as to venture to give names to them.

ART. V.—*Observations made at Paramatta on the Inferior Conjunction of Venus with the Sun, in Oct.* 1823. By his Excellency Sir THOMAS BRISBANE, K.C.B. F.R.S. Lond. and Edin. Communicated by the Author, in a letter to Dr. Brewster.

MY DEAR SIR,

IN addition to the scientific communications which I have already transmitted to you, I beg leave to add another, on the inferior conjunction of Venus with the Sun; a species of observation which, I believe, has never before been made in the southern hemisphere, and which may perhaps throw some farther light on the parallax of that planet. I regret that there was no large star near Venus, in order to have compared it with her.

The observations on the stars now sent have been made more with the view of exhibiting the state of the mural circle with which the observations were made than for any other purpose.

As Mr. Rumker's health has been so bad for the last three months, that he has been obliged to retire into the country about forty miles off, the observations have been entirely made by myself and Mr. Dunlop, in whose accuracy I have the most perfect confidence.

I have seen your Journal as late as April, in which I always find valuable matter. And I therefore wish you to use any communications I may send you from time to time as you may wish; as my sole object is the general extension of science;—and observations lose more than half their value if they are not circulated.

I think the activity of the observatory will not be diminished by Mr. Rumker's absence. I am preparing to observe the solstice, which will be the fifth observation of it I shall have made with the same sixteen-inch repeating circle of Reichenbach. In the course of these observations, I shall have run through nearly 10,000 degrees, as I never unclamp the instrument but for repetition for the three weeks I am observing.

Trusting to hear from you soon, I remain,

My Dear Sir,

Yours most faithfully,

THOMAS BRISBANE.

Government House, Paramatta,
New South Wales, Nov. 3, 1823.

Difference in Right Ascension and Polar Distance of Venus and the Sun, as observed by the Mural Circle, Paramatta, October, 1823.
(The Stars are intended only to show the position and state of the Instrument.)

October, 1823.	Barometer.	Thermom. Fahr.		Polar Distances.				Transit over the Meridian by the Mural Circle.	Clock slow by the Mural.	Remarks.
				Microscopes.						
				I.	II.	III.	IV.			
October 6.	30.120	72°	⊙ Upper limb	84° 56′ 26″ 2	24″ 0	13″ 5	16″ 2			
—	30.120	73.	♀ Lower limb	74 49 1 0	6 3	50 3	1 8			
Next morning, —	30.060	66.	β Argo	20 59 17 6	18 2	15 2	11 0			
7.	30.032	79.	⊙ Lower limb	85 5 27 7	24 5	18 0	16 2			Tremulous.
—	30.032	79.	♀ Lower limb	75 5 25 2	26 8	11 8	22 2			
—	30.000	66.8	β Argo	339 1 6 5	10 2	12 4	6 4			(Subpolo) faint cloudy.
Next morning, 9.	29.784	70.5	β Argo	20 59 18 9	20 2	17 3	12 2			
—	29.716	78.5	♀ Lower limb	76 1 50 0	53 1	35 0	49 6	12h 51′ 18″ 6		
10.	29.716	78.6	⊙ Upper limb	83 24 22 3	21 2	13 0	17 5	12 58 8 7		
—	29.716	78.	Antares	63 55 44 7	48 1	32 8	37 7′	16 17 57 8	39″ 10	
—	29.760	62.6	β Argo	339 1 9 0	8 8	11 1	6 3			Sub polo.
Next morning, —	29.800	72.8	♀ Lower limb	76 22 30 6	33 7	15 0	26 4	12 49 11 1		
11.	29.800	72.8	⊙ Upper limb	83 1 34 2	28 1	20 2	23 0	13 1 46 8	41 19	
—	29.800	63.8	α Lyræ	128 32 41 0	46 0	37 8	39 2	18 30 16 7	41 80	
Next morning, —	29.618	74.	♀ Lower limb	76 44 2 2	9 0	50 9	3 8	12 47 10 1		
12.	29.618	74.	⊙ Upper limb	82 38 44 5	46 2	33 2	41 5	13 5 26 1		
—	29.618	75.	Antares	63 55 44 7	45 8	31 8	37 8	16 17 53 4	43 80	
Next morning, 15.	29.360	71.2	♀ Lower limb	78 15 56 0	59 0	46 0	52 3	12 39 9 1		
16.	29.360	72.0	⊙ Lower limb	81 41 12 2	13 8	59 2	10 5			
Next morning, 19.	29.764	76.	♀ Lower limb	79 40 16 5	24 3	5 8	16 0	12 32 44 0		
20.	29.764	77.	⊙ Upper limb	79 40 54 8	1 8	41 3	51 8			
Next morning, 21.	29.558	81.5	♀ Upper limb	80 34 44 2	46 3	32 3	43 2			
22.	29.554	84.5	⊙ Upper limb	79 57 47 6	56 2	35 2	49 0			
Next morning, —	29.650	73.	♀ Upper limb	80 56 38 4	41 7	26 7	35 2			
Next morning, 23.	29.534	74.	♀ Upper limb	81 17 49 7	54 2	37 1	49 0			Very faint.
24.	29.534	77.	Antares	63 55 46 0	46 4	33 5	39 7			
Next morning, —	29.605	68.5	♀ Upper limb	81 38 21 1	21 9	4 5	18 4			
25.	29.590	72.8	⊙ Lower limb	78 26 39 8	43 2	29 4	37 4			
—	29.590	71.	Antares	63 55 43 9	48 0	32 0	38 1			

ART. VI.—*On the Circular Sterns of Ships of War.* By GEORGE HARVEY, Esq. F.R.S.E. M.G.S. &c. Communicated by the Author.

IN consequence of an article which appeared in the 18th Number of the Edinburgh Philosophical Journal, on the Circular Sterns for Ships of War, I have been induced to resume the investigation of that subject, and by a further examination of several ships, with sterns of both kinds, in the harbour of Hamoaze, Plymouth, to discover if any real grounds existed for the opposition this truly excellent plan has received. And, after giving it the most deliberate consideration, I would observe, that *both as regards the mechanical strength of the ship, and the improved means of defence it affords, on many difficult and trying occasions, from the action of the sea, and the shot of the enemy*, I can arrive at no other conclusion than that *the system ought to be decidedly persevered in, and by no means abandoned or compromised;* and that to return to the *weak and defenceless form of the square stern*, would only be to restore *a barbarous and imperfect remnant* of a system of ship-building, which ought, long ere this, to have been banished from the dock-yards of a great and enlightened nation like our own.

It may not perhaps be known to some of the readers of the Edinburgh Journal, that *the application of circular sterns to ships of war, forms a necessary and important part of the improved system of ship-building*, latterly introduced into the public service by Sir Robert Seppings, and that without *the full and perfect application of it, to ships of all classes, this excellent system will be rendered in a considerable degree ineffectual.* Indeed, the necessary and essential connexion between the *diagonal trussed frame*, the *shelf-pieces*,* and *thick water ways*, and their peculiar adaptation to the form of the circular stern, renders it impossible to separate either from the new system of ship-building, without producing a most important injury to public service.

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* Mr. Knowles, in his valuable work *on Preserving the Navy*, observes, "It is but justice to acknowledge, that the great benefit which naval architecture has derived from the introduction of shelf-pieces, is due to the French."

The general and unexceptionable merits of the diagonal system are now universally acknowledged, but the advantages resulting from the shelf-pieces and thick-water ways, and the admirable mode by which the beams are connected to them, by means of coaks and bolts passing through the whole, although clearly understood by those well-informed men, who have turned their attention to the inquiry, have, nevertheless, not attracted so largely the attention of the scientific world, as might have been expected. Their advantages, however, are as unquestionable as those resulting from the diagonal trusses; and there can be no question but the *longitudinal strength* communicated by the latter, would be considerably diminished, if the *lateral strength* afforded by the former were removed, or in any great degree impaired. Hence, without an intimate and perfect union of the advantages resulting from both, and which can alone be done by the perfect application of circular sterns, the separate strengths afforded by the two can never be effectually united. In ships with square sterns, the application of the diagonal system of trusses does not produce its maximum effect, nor is the continuity of the shelf-pieces preserved, since the most abrupt termination of them takes place at the quarters, a difficulty entirely removed in the circular form by the happy introduction of the ekeing, and affording a perfect illustration of the term "internal hoop," so appropriately applied to them by Sir Robert Seppings.

The opponents of the circular stern are therefore impeding the advancement of naval architecture most essentially, by endeavouring to prevent its introduction into the public service; nor can I comprehend by what erroneous and mistaken views those are guided, who endeavour, in the face of reason, the clear and evident principles of mechanics, and of every sound and legitimate conclusion of science, to resist the progress of a system of ship-building, which it will be the honour of this age to have produced.

It has long appeared to me that this much controverted question, divested of the questionable and trifling considerations relative to beauty of external form, is capable of being reduced into a very narrow compass, and of admitting of a fair and perfect demonstration. In the *first* place, it cannot be denied, but that circular sterns remove a form, notoriously weak and feeble, (in truth, the weakest part by far of the ship,) and possessed of no one excellence to recommend it; and, *secondly*, That the form substituted, possesses in a pre-eminent degree, all the essential attributes of mechanical strength, and under many difficult circumstances, is capable of affording the most effectual and perfect defence, which the other, under the same circumstances, would be altogether incapable of yielding. Now, if the sailing qualities of a ship are not impaired by the change, and that they are, cannot be satisfactorily proved, mechanical strength, and superior means of defence, are all the requisites that can be reasonably denied, and that time will triumphantly prove these advantages to result from the application of the circular stern, is what I most firmly believe. It will not be the first case in which praise and approbation have been slowly obtained.

I am rather at a loss to discover, whether the author of the paper which has occasioned these observations, be really a friend to the introduction of the circular stern or not, since many of his remarks partake of an ambiguous character. There are some points of the paper, however, to which I wish to direct the attention of your readers. In the *first* place, it is contended, (page 354,) that in case of a round stern vessel getting on the quarter of a ship, "the fire of at least the aftermost gun on the broadside, when in that position, is *entirely lost.*" Now this is by no means the case, as I have proved by actual experiment, and, indeed, from the known fact, that circular stern ships are all equally broad, and generally considerably broader at the aftermost broadside port, than similar ships with square sterns, the gun must necessarily act with at least equal effect.

In the *next* place, no statement has ever been made, that as many guns could not be fired *right aft*, in the square stern, as in that of the circular form. Now, although the right-aft fire has not been the point in question, still, as it has been alluded to by the author of the "Observations," it may be proper to remark, that the superiority of the circular stern, in point of convenience of working the guns, is considerably increased, and the chances of fire very much diminished, for I have found, from actual experiment, that when an eighteen pounder was trained right-aft on board the Hamadryad, a forty-six gun frigate, having a circular stern, the muzzle was *beyond* the outer side of the stern eighteen inches, whereas, the same gun, similarly placed on board the Boadicea, a ship of the same class, but with a square stern, had its muzzle twenty-one inches *within* the rail, or eight inches *inside* the sill of the port. And, with respect to training the guns in the last mentioned position, the superiority was so great in the ship with the circular stern, as to call forth the warm admiration of several experienced and intelligent naval officers who witnessed the experiments.* In the circular stern, the right-aft guns could be readily made to sweep horizontal arcs of seventy-six degrees, with the utmost ease, and without disturbing a single lining; but, in the square stern, after removing all the linings of the ports, so as to present the naked timbers, the utmost amplitude that could be obtained for the right-aft gun was 59°, a difference by no means inconsiderable, and to be attributed altogether to the superior form of the round stern, and to the improved modes of timbering. Nor was the arc for the square stern obtained without much more exertion and care than could be bestowed on such a point in the day of battle. Added to this, in ranging the gun in the former case, the muzzle was always *without* the external edge of the port, but in the latter, the gun, when trained to its greatest angle, had its muzzle thirty inches *within* the rail, or sixteen inches *inside* the sill of the port, thus increasing considerably the danger from fire.

In the same page also, a singular allusion is made to the poops of brigs, as if they possessed some latent connexion with circular sterns. Poops, however, were not added to brigs by Sir Robert Seppings, and, if they had, it would be somewhat difficult to trace their relation to circular sterns.

In another part of the same page, an allusion is made to alterations *said* to have taken place in the circular stern of the Vengeance, now building at Pembroke; and the author expresses his regret, " that such *extensive alterations* should be carried on before the inventor's ideas are *matured* on the subject." With respect to these "*extensive alterations*," I find, from the most unquestionable authority, that they amount to no more than a simple change of the water closets from one situation to another. "Extensive alterations" have not therefore been made, excepting the trifling changes here alluded to can be characterised as such. But, granting, for the sake of argument, that "the inventor's ideas are *not* matured on the subject," but which no one will admit, who is acquainted with the high professional talents of Sir Robert Seppings, and with the great caution which has always distinguished him in his mechanical investigations, ought it to be regarded as an anomaly in the history of human improvements, that minor alterations have been made from time to time, in a plan of acknowledged importance? Can a single instance be selected from the boundless catalogue of examples of mechanical skill, of which this country has the happiness and the honour to boast, in which the subject started at once from the fertile mind of its inventor, into general or even partial application, with no change between the first example of its powers, and that which graced its final triumph? Was the *first* steam-engine of the immortal WATT possessed of *all* the excellences and advantages of that which his latter years produced, when time had enabled him to contemplate more perfectly the relations and properties of all its parts, and to bestow on them all the benefits capable of being imparted by a mind like his, improving daily its powers by new accessions of mechanic skill? Does the suspension bridge across the Menai exhibit no proofs of superiority over that of the Tweed? And does the ingenious and active constructor of the latter claim for it no higher distinction in the scale of excellence than that afforded to bridges of the kind when constructed of simple wire? Time and experience are at all times necessary to perfect mechanical, as well as every other improvement; and when it is considered, that circular sterns form so necessary and essential a part of the improved system of ship-building—an art identified more intimately than any other with the most vital interests of the country—it is not too much to claim for it, that fair and proper time for its improvement to which every other branch of art has been hitherto entitled.

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* I ought particularly to acknowledge, in this place, the handsome assistance I received from Captains Wise, Arthur, and Richards, of the Royal Navy, in prosecuting this interesting and important subject.

The author of the paper under consideration makes also an allusion to the examples furnished by Sir Robert Seppings, of weakness in the square stern, and would have it understood, that one hundred and twenty were all the instances the ingenious author of the circular stern could discover among the documents to which, from his official situation, he must necessarily have had access. Now, although in most experimental inquiries one hundred and twenty cases would be considered as forming no very unexceptionable grounds for inquiry; still, if stronger evidence be wanting, of the necessity of change in the square stern, *many more instances* might be obtained by "ransacking records;" since Sir Robert Seppings, at page 5 of his letter to Lord Melville, when alluding to the examples of weakness furnished in its appendix, observes, that "the list could have been *considerably increased*, had he not considered it as affording ample evidence to prove the insufficiency of the square structure." And had the author of the diagonal system felt disposed to collect instances of "ships being weak in the bows," he might have referred to a period when weakness also characterized that important part of a ship; and have contrasted the results which such an examination would afford with these proofs of superior strength which the records of the navy must necessarily present, since the introduction into the naval service of his circular bow; nor is it improbable but that such a comparison would afford many strong and powerful arguments in favour of a change of form in the square stern.

More examples, however, than what Sir Robert Seppings has already furnished are scarcely necessary to convince a candid and unprejudiced mind, that the square stern is decidedly the *weakest* part of a ship, both as regards its mechanical strength and its means of defence; and that it therefore becomes an object of national importance to improve its construction.

According to the author of the "Observations," the examples of weakness quoted in my former paper, only prove "an almost invariable tendency in the sides to separate." Now, although this of itself is a sufficient reason to prove that some change is necessary, it will nevertheless be found, that examples of *general weakness* in the stern are far from being uncommon. For instance, in the report relative to the Valiant, it is stated, *that the stern post, and* ALL *the stern works;* that in the Diadem, *the afterpart of the ship sunk so much, as to cause a considerable friction of the rother against the post;* and in the case of the Adamant, *the stern frame was so very much depressed, that the stern timbers were nearly out of their steps on the wing transom.* In one remarkable instance also, of the Courageux, *the working of the stern frame was so great in a heavy gale of wind, as to occasion the loss of five tillers;* and on the storm assuming afterwards a still more tremendous character, *the working about the stern frame and post was so great, as to render it necessary to throw twelve of her after guns overboard, to ease and lighten her.* And in a similar scene of peril, in which the Albion was situated in 1809, thirty-one guns were thrown overboard, *twenty-four of which were from the after extremity of the ship.* Nor is it always necessary for a gale of wind to exist, in order to prove the weakness of the square stern, since, in the example of the Defence, *the heels of her counter timbers were reported by her Captain to work very much, even in moderate weather.* And the stern of the London was found *to tremble much in light winds, and to increase its motion considerably in heavy seas.* In the Aquilon also, *the stern frame was found to be much shook by firing the after guns.* The poop of the Bellona was found likewise *to labour so much as to work the foremost bulk head partly down;* and *that when the Minotaur rolled, the whole body of the poop went over from side to side. The stern of the Cumberland* also, *above the wing transom, worked so much as to force the Oakum out of the butts of the lower counters, at the rabbit of the stern post, as likewise out of the seams of the lower counters.*

Such are a few of the striking examples on which Sir Robert Seppings grounds his arguments for a change in the figure of the stern; facts which had been silently accumulating for a long period in the records of the Navy Office, awaiting the hand of a "master," to draw from them unquestionable proofs of the general weakness of the square stern, and, at the same time, to afford the elements and principles of a better system;—a system which should add, in no inconsiderable degree, to the strength and security of our ships of war.

I forbear entering, on the present occasion, into the superior means of defence afforded by the circular stern, because it is my intention to give the results of a series of actual experiments on this subject in another paper.* But I would observe, in reference to the celebrated retreat of Admiral Cornwallis, that it by no means follows, because they were only able to fire right aft, that guns in the quarters could not have been advantageously employed; and I conceive that no better example could be afforded of the superior means of defence, afforded by the round stern, than the case of a small number of ships chased by a superior force. A gun at the quarter, under such circumstances, would be at least as serviceable as one right aft.

The author of the "Observations" must also be, in a great degree, a stranger to the fitting of the iron railing in ships of the line, or he would have known, that it is so contrived as to open and fall back in the wake of the guns without producing the smallest inconvenience; and, with respect to the danger to be apprehended from fire by the projection of the platform, no greater can arise than that produced by firing over the channels, which is the case with the greater part of the guns on the forecastle and quarter deck. I am also of opinion, that few naval officers could be found who would think of transporting an after gun forward, or a forward gun abaft, when his ship was attacked at either extreme. The most natural course of proceeding, under such circumstances, would be, to place the aftermost gun in one of the aftermost vacant ports, and the foremost gun in either of those forward. It would be a singular mode of defence, to transport a gun from one extremity of the ship to the other; nor has it ever been intended to keep the stern ports armed with additional guns.

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* These experiments were performed in the presence of several distinguished naval officers; and I may briefly add, that the results were so decidedly in favour of the Circular Stern as to leave not the smallest doubt in the minds of all present, of the immense advantages it possesses over the square form.

With respect to the range of the guns, in the diagram referred to in my former essay, I hope in another paper to prove, that *the circular stern admits of a ready and perfect defence, of more than an entire semicircle,* without "wooding the guns," or depriving the men of sufficient room for working them. If also the line DH, in the diagram contained in the paper under consideration, be intended to form a right angle with the longitudinal axis of the vessel, a greater advantage than what this position will afford can be obtained. For I have found by experiment that the gun can readily be trained to an angle of 79 degrees, or, in nautical language, one point *before* the beam; giving, therefore, a greater advantage to the gun, at the quarter, than contended for by the author of the "Observations."

I feel no ordinary pleasure in stating my belief, that the hostility which was once so vigorously displayed against the circular stern, is now considerably diminished. The torrent of feeling, which seemed at first destined to overwhelm the improvement, has in some measure subsided. The disapprobation of change, which at one time assumed the loud voice of thunder, has insensibly melted into tones of a gentler kind. Inquiry has been awakened; and many who imagined they saw in the alteration, indications of decay in the martial energies of our marine, now contemplate it with relation to the superior strength it affords, and the more ample means of defence it unfolds. Some, however, faithful to the ancient form, still regard the circular stern with unabated hostility. But to such it may be said, are we to arrest the march of architectural improvement? Is the new principle of ship-building, which has already conferred such transcendent advantages on our country, and which is now introduced into most of the naval establishments of Europe, to be deprived of one of its essential elements? While every other part of our men of war, has received accessions of strength, is the stern to remain in all its primitive weakness, without receiving a single benefit, from the science, and enlarged experience, that have been latterly applied to ship-building? Can such an anomaly long remain to mock the efforts of modern improvement? Is the naval engineer to be doomed perpetually to reflect, that in the magnificent bulwark he has raised, science has lent her best efforts to strengthen the mighty frame, in all its parts, excepting one? Or is the old system to be persevered in to afford another exemplification of the maxim, "that partial strength is general weakness?" Is it consistent with that noble spirit of advancement, which so pre-eminently characterizes the age, and which in its general operations, confers so great a lustre on our own beloved country, to allow mere feelings of convenience, and vague and uncertain notions of beauty, to stand in the way of genuine improvement? Shall we, who have even shaken off those ancient commercial restrictions, which seemed identified with our very national existence,—which had grown with our growth, and attended us in the brilliant career of our glory and power, refuse, in the present instance, to abandon an ancient form, opposed to every principle of genuine science? Rather let us, by the universal adoption of the circular stern, prove that we only adopt a system which sound experience sanctions; and that we only advance another, but a most important step, in the career of that improvement, which has been latterly introduced into ship-building; and that we are no longer enemies to the doubtful forms of beauty, than when they stand opposed to the progress of real improvement.

The period, however, I confidently hope, is not far distant, when the circular stern will be contemplated by all with more real pleasure than that form which has nothing but time, and the false perspective of centuries to recommend it; shedding new lustre on the name of its celebrated author, and adding to the other intellectual trophies he has achieved, one not the least valuable; since it will carry with it the unerring symbol of truth, having made its way, amidst prejudices of no ordinary cast, and in spite of an opposition of no ordinary kind; time having proved its unquestionable merits, and numbered it among its choicest and most valuable treasures.

PLYMOUTH, *March* 6, 1824.

ART. VII.—*An Account of a Genus including the Herba Toxicaria of the Himalaya Mountains, or the plant with which the natives poison their arrows.* By FRANCIS HAMILTON, M. D. F. R. S. &c. Lond. and Edin. and F.A.S.E.

[Having lately had an opportunity of seeing, in the Herbarium of Dr. Francis Hamilton, at Leny House, specimens of the plants with which the natives of certain parts of India are wont to poison their arrows, we expressed a desire that the characters and descriptions of these might be given to the public; and that gentleman, with the liberality which he has ever displayed in furthering the cause of science, has kindly communicated to us the following particulars.—W. J. HOOKER.]

IN June, 1810, being on the frontier of Nepal, I sent a man to the alpine regions of the Himalaya mountains, beyond the sources of the Kosi river. He was to collect specimens, roots, and seeds, of the alpine plants, having for some time been trained in drying specimens, and preserving seeds; and his attention was particularly directed to procure the plant used in India for poisoning arrows. In July he returned with no great store; but, among his acquisitions were specimens of the poison plant, and of two other species of the same genus, which has entirely the habit of several species of *Ranunculus* and *Trollius*. In my Account of Nepal, I have made the following observations on these plants, which may serve for giving the reader an idea of their history; and this I shall here follow up by botanical descriptions of the specimens, which were unfortunately imperfect.

" The term *bish* or *bikh*, according to the pronunciation of the same letters on the plains, and in the mountains, is applied to four different plants with tuberous roots, all in great request. I have already mentioned the *Singgiya bish*, as found on the lower mountains and hills, and supposed it to be a species of Smilax. The others have not the smallest resemblance to it, but are so strongly marked by a resemblance to each other, that I have no doubt of their all belonging to the same genus, although I have only seen the flower of one. This is called *bishma* or *bikhma*, and seems to me to differ little in botanical characters from the Caltha of Europe. The *bishma* or *bikhma* is also, I believe, called *mitha*, although I am not certain but that this name may be also given to the following species, which deserves the most serious attention, as the *bikhma* is used in medicine, and is a strong bitter, very powerful in the cure of fevers, while the plant that will be next mentioned is one of the most virulent poisons."

"This dreadful root, of which large quantities are annually imported, is equally fatal when taken into the stomach and when applied to wounds, and is in universal use throughout India for poisoning arrows; and there is too much reason to suspect for the worst of purposes. Its importation would indeed seem to require the attention of the magistrate. The Gorkhalese pretend, that it is one of their principal securities against invasion from the low countries; and that they could so infect all the waters on the route by which an enemy was advancing, as to occasion his certain destruction. In case of such an attempt, the invaders ought, no doubt, to be on their guard; but the country abounds so in springs, that might be soon cleared, as to render such a means of defence totally ineffectual, were the enemy aware of the circumstance. * This poisonous species is called *bish*, *bikh*, and *kodoya bish*, or *bikh;* nor am I certain whether the *mitha* ought to be referred to it, or to the foregoing kind."

"The *nirbishi*, or *nirbikhi*, is another plant of the same genus, and, like the first kind, has no deleterious qualities, but is used in medicine. The president of the Asiatic Society, in a note annexed to Dr. Roxburgh's account of the Zedoary, gives the *nirbisha*, or *nirbishi*, as a Sangskrita or Hindwi name of that plant, which has not the smallest resemblance to the *nirbishi* of the Indian Alps. In fact, the nomenclature of the *materia medica* among the Hindus, so far as I can learn, is miserably defective, and can scarcely fail to be productive of most dangerous mistakes in the practice of medicine."

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* "In fact, our troops, in a subsequent invasion, suffered nothing from such means; nor do I believe that they were attempted."

The specimens of the *Bishma* which I have given to the India House are, in the catalogue, called *Caltha bisma*, although it differs much in habit from the *Caltha palustris*; and it has only four petala, and four germina, which may perhaps induce some to consider it as a new genus.

CALTHA BISMA.

Radix tuberosa. *Caulis* herbaceus, simplex, cubitalis, glaber. *Folia* caulina plura alterna, petiolata, cordata, subrotunda, glabra, venis reticulata, subquinquenervia, quinqueloba lobis cuneatis, apice incisis, acutis. *Petiolus* longus, amplexicaulis, glaber.

Panicula terminalis, rara pedunculis elongatis, paucifloris, ex apice caulis, vel ex foliorum superiorum axillis. *Bractea* subsessilis, trifida, parva, pedicello paulo infra florem posita. Flores parvi, erecti, virides, extra nigricantes.

Calyx nullus. *Petala* quatuor, crassa, ovalia, concava, obtusa, ruda. *Filamenta* plura, hypogyna, brevissima. *Antheræ* erectæ, bisulcæ, utrinque emarginatæ. *Germina* quatuor subulata, polysperma. *Styli* crassi, subulati. *Stigmata* simplicia, acuta.

The specimens of the Nirbishi sent to the India House I have called

CALTHA NIRBISIA.

Radix tuberosa. *Caulis* herbaceus, simplex, glaber. *Folia* caulina plura alterna, petiolata, cordata, triangularia, pilis raris brevibus, marginem versus aspersa, subquinquenervia, venis reticulata, lobis cuneatis incisis acutis quinquefariam divisa. *Petiolus* longissimus, amplexicaulis.

The specimens of the *Kodoya bish*, or *Radix toxicaria*, which I sent to the same collection, are called

CALTHA CODUA.

Radix tuberosa. *Caulis* herbaceus, erectus, cubitalis. *Folia* caulina plura alterna, utrinque pilosa, nervosa, venosa, ovata, peltata, lobis multis incisa cuneatis, iterum lobatis. *Lobuli* obtusiusculi, incisuris duabus apicem versus folii profundis.

ART. VIII.—*Observations on the Physical Geography of the South of Africa.* By JOHN DAVY, M. D. F. R. S. &c. Communicated by the Author.

THE day upon which we anchored in Table Bay was particularly interesting. As we sailed along the shore, seldom more than three miles off, we had a fine view of the bold coast, extending from the Cape of Good Hope to Table Bay. The weather was favourable, and the wind was blowing a gale from the south-east. Although we seldom obtained a glimpse of Table Mountain, through the cloud which hung over it, yet we could easily distinguish the minute features of the lower hills, many of which rose abruptly from the sea. The character of the scenery of this shore is naked boldness. Nothing presents itself to give an idea of fertility or cultivation. Not a tree is to be seen, nor a field, nor a green patch; and till near Table Bay, not a dwelling nor a vestige of man. Rugged rocks—heaps of sand—parched hills—arrest the eye in every direction. This is the dry season, and no doubt the country, which is naturally arid, appeared to disadvantage.

It was curious to observe how the wind passed down through every opening of the mountains. Even at the distance of a mile or two from land, the wind, which was blowing directly off it, was impregnated with fine dust, which produced a very unpleasant effect upon our eyes.

The very great haziness all round the horizon, was very remarkable, as well as the clouds, which, notwithstanding the violence of the winds, rested on the Table Mountain and the higher hills. The formation of this haziness, and of the clouds on the hills, is no doubt connected with the great difference of temperature, in the first instance, between the south-east wind, and the current which it crosses, and again between this wind and the temperature of the water near the shore.

March 18.—In Table Bay, 5^h A.M. 75°, 52°, 5° S.E. strong; the sky was pretty clear, and a cloud on Table Mountain. After breakfast we landed. As the dust was blowing about so as to be very troublesome, the glass windows in the house we inhabit, are, according to custom, closed, so that the air is unpleasant, hot, and close. The temperature of the room at 3h P.M. is 75°.

March 19. *At Cape Town.*—The following are the specific gravities of the salt water which I took up at sea in different places. They were obtained by a small balance. The experiments were made in a close room, and most of them repeated twice, the temperature of the air being 76°, and that of the water tried 80°.

	Latitude.	Longitude.	Specific Gravity.
1.	4° 10′ North	80° 15′ East	10250
2.	0 5 South	81 37 East	10264
3.	7 10 South	82 26 East	10250
4.	9 3 South	81 0 East	10250
5.	12 52 South	79 57 East	10245
6.	19 15 South	71 56 East	10264
7.	21 32 South	69 29 East	10264
8.	23 32 South	66 49 East	10264
9.	24 34 South	61 56 East	10264
10.	26 7 South	55 48 East	10259
11.	27 55 South	50 7 East	10259
12.	29 21 South	45 5 East	10259
13.	30 51 South	37 12 East	10259
14.	32 50 South	32 26 East	10259
15.	33 41 South	29 16 East	10259
16.	35 41 South	24 13 East	10259
At the anchorage in 7 fathoms in Table Bay 1½ mile from land			10250
On the shore near the Jetty,			10250
Water from the stream from Table Mountain,			10000

March 23*d*, *Cape Town.*—The temperature of the fine stream with which Cape Town is supplied with water from Table Mountain, was 73° at the fountain, and 87° at another place, a difference arising from local causes. The temperature of a well behind the house at Green Point, was 63°. It was in a sandy soil, resting on clay, about 80 feet deep, and protected from the weather by a well-roofed little building. The range of the thermometer in Cape Town is said to be about 20° above or below the mean temperature, occasionally reaching 86° in the hottest weather in summer, and falling to 32° in winter. Now and then a little ice has been observed on a small pool at Green Point. A change of 30° or 32° of temperature has been observed to take place in twenty-four hours.

The prevailing winds here are the south-east and north-west, the former blowing during the summer and autumn months, and the latter during the winter and spring. The south-east wind is generally dry and hot, and often so violent as to upset carriages. In the latter end of autumn, this wind is occasionally cold. When it prevails, a cloud generally rests on Table Mountain. It is probably heated in its course overland from one shore to the other.

The north-west and north-east winds are cool and moist. The rainy season is the winter. The rains in winter are heavy, and are said to last sometimes several days without interruption. Showers occasionally occur in spring, autumn, and summer, and are generally slight. The barometer stands unusually high during the south-east winds.

Clouds are seen on Table Mountain, not only during the south-east winds, but likewise during the north-west; and indeed whenever the wind, from whatever quarter it blows, is violent. On the contrary, during calm weather, or when the wind is gentle, the mountain is generally uncovered.

March 27th.—Accompanied by Colonel Hardy, I yesterday ascended Table Mountain. We set out on foot at 11 o'clock A.M. and reached the summit about 2 P.M. and after remaining on the mountain about two hours we descended. During our ascent the sun was very troublesome, and the heat rather oppressive. In some sheltered places the stones in the path were so much heated that they could scarcely be held in the hand. On the summit the air was cool even in the sunshine. The shade of the mountain having preceded us during our descent, we enjoyed the cool air, scented with sweet-smelling shrubs, which are here very abundant. The sky being very clear on the top, we had a fine prospect of the country below, of Cape Town and Bay, and of the distant mountains; and the nearer views of the scenery around us were truly grand. Nothing can be finer than the lofty and bold cliffs, and chasms, which present themselves to the spectator when looking down over the brink of the Table land.

As soon as I arrived at the Table land, I left my barometers in the shade to cool, and to acquire the temperature of the air. At 8h 30′, I observed them. My short barometer did not act, as the height was not sufficiently great. The long barometer, held by the hand, as there was no shrub high enough to suspend it from, was stationary at 26in..95, the attached thermometer being at 85°, and the unattached one at 83°. The evaporation was 13 degrees.

At 9h P.M. after my return to Cape Town, the barometer stood at 30in..25, the attached thermometer being 69°, and the unattached one 63°. The height of the mountain appears therefore to be 3308 feet. Lieutenant Rivers of the R.N. found it by repeated trigonometrical measurements to be a little more than 3000 feet above the level of the sea. It is probable that at the time when my observations were made on the mountain, the barometer at Cape Town was not so high as at 9h P.M.

April 12.—I went yesterday to visit a fountain, which was considered to be interesting, and with the view of ascertaining its temperature. On the declivity of a hill, about 50 feet above the level of the sea, a pit was sunk in the form of a parallelogram, 16 feet by 12, and about 6 feet deep, and lined with masonry. The floodgate was open, and the water in the cistern was only about two feet deep, with a pretty quick running current. It was perfectly transparent, and the water could be seen rising up in many different places, out of a pretty compact clayey bottom, formed by the decomposition of granite. It springs in sufficient quantity to work, without an additional drop of water, a mill of considerable size. The water is always coldest in hot weather, and hottest in cold weather; and its temperature was about 63° at 5h P.M. that of the air being 69°.

Since I arrived here, we have made three different excursions into the country, to Constantia, to Stellenbosch, and the Paarl, and to Hottentot Holland and the Kloof of the same name. On two occasions we travelled according to the style of the country, in a light strong cart and four horses, and in another in a light waggon drawn by eight horses, and up the Kloof in the common country waggon, drawn by twelve oxen. Here the horses are always driven in hand, whether a single pair or six pair are used, twelve in hand not being an uncommon occurrence. Two men are required both for the horse and the ox waggon. A Hottentot leads the four pair of oxen; and the driver, provided with a long whip, rides in front of his waggon, or runs beside it. In managing a horse waggon, the whip is the charge of one, and the reins of another postilion.

We visited Constantia at the time of the vintage. Mrs. Collins and family gave our party a most hospitable reception. We walked over the vineyard, and through the vine storehouse. The short vine bushes were loaded with grapes, some yellow, and another kind dark purple, of both of which Constantia wine is made, the colour of the wine corresponding with that of the grape. Before the grapes are plucked, they are allowed to be quite ripe. Many of the bushes, indeed, were almost dried, and converted on the trees into raisins. The Constantia grape is remarkably luscious, and must contain a large proportion of sugar, and the wine is merely the fermented juice of this grape. Mr. Collins, junior, denied that the honey plant is used in the manufacture. When the grapes are quite ripe, they are brought to the wine-store, and the fruit is separated from the stalk, by means of a sieve, whose meshes are large enough to allow the grapes to pass, while the stalk is detained. A slave operates with his hands, rolling a heap of bushes in the sieve till the fruit is detached, and he does it with great rapidity. The grapes are then thrown into a vat, and the juice, after being partly trampled out by slaves, is drawn off and put into a press. The trampled fruit is then put into the same press, and by the action of a screw as much juice as possible is procured. The juice is then poured into casks, and allowed to ferment.

In our excursion to Stellenbosch and Hottentot Holland we crossed the Cape Flats, as the plain is called, which lies between Table Bay and False Bay, flanked on one side by the mountain ridge, extending from Table Mountain to that above Simon's Town, and on the other, by low hills parallel to the low chain of the Hottentot Holland Mountains. The broadest part of these flats may be about twenty miles, and the whole may be regarded as a good example of African sandy deserts. The ground is in general flat, and the inequalities, which are inconsiderable, are mostly formed of sand, sometimes of clay: and, in one or two places where the ground rises, there are masses of calcareous rock, either level with the ground or projecting very little above it. Besides these inequalities, there are elevations of land deserving the name of sand hills, some of which appear to be fixed, from the vegetation with which they are clothed. The plants which grow upon them are different kinds of heath, and some low shrubs. Some of these elevations appear to be shifting, being composed of fine sand, and quite naked, without the slightest trace of vegetation. Some of them are thirty feet high. These sandhills seem to lie in the course of the prevailing wind, viz. the south-east, and have been probably formed by its action.

It has become a question whether the sea ever covered those flats which connect Table and False Bay. Those who maintain the affirmative side of the question, found their opinion on the sandiness of the plain, on the lowness of the ground, and on its locality between these bays. I am disposed, however, to think that this opinion is not well founded; from the existence of inequalities now above the level of the sea, consisting of clay, and of calcareous rock; from the circumstance of shells not having been discovered in the limestone; and from the sand having a less resemblance to sea-sand than to that which arises from the decay of the sandstone which forms the summit of the adjoining hills. It contains no pebbles, and no remains of corals or shells, with the exception of a few fresh water shells.

The heat on these plains is often very intense, and, during the prevalence of a strong south-east wind, they are almost impassable. The direction of the routes is often changed, in consequence of the shifting of the sands, so that experienced guides are necessary.

From the depth of the sand a great force is requisite to drag the vehicle along. A light waggon requires eight horses. One light spring cart had only four, but they were very strong. We travelled at the rate of twenty-five miles in nine hours, and, excluding the good part of the road, we took about seven hours and a half to traverse about seventeen miles of sandy flat.

In crossing these flats we observed an example of a stream losing itself in the sand. During part of the way our route lay through its moist and almost dry bed. The sand was bound a little by the moisture, and where the moisture was not in excess, this part of the way was pretty good.

The calcareous rock which occurs pretty abundantly in these flats, is generally greyish or yellowish white, and its texture is most commonly earthy. It is generally soft and prickly, and not unlike chalk, containing some sand and siliceous gravel. I am disposed to consider it as a formation deposited from water. It is much used by the farmers, and makes good lime. It appears to be confined to low ground; and I was informed that it is not found any where but in the Cape Flats.

The country between the Cape Flats and Stellenbosch, extending about five miles, has a dreary aspect. The low hills, over which the road passes, and along which it winds, is formed of decomposing granite, and is covered with heath and low shrubs. The appearance of Stellenbosch in the valley, as seen from the hill at a distance, is pretty, and particularly from its contrast with the dreary scene around. It seems, at a distance, to be a much smaller place than it really is, as the greater part of the town is hid by the oak trees, which are planted in rows on each side of every street. In crossing the hill, above the Sandy Cape Plain, the attention is particularly arrested by the fine chain of mountains that extend across the country from sea to sea; the first range bounding, on one side, the valley of Stellenbosch. Many of the hills are pointed, and one or two have flat tops. They exhibit a variety of forms, and are all very steep; the sides and summits of the boldest appearing to be bare rock. They seem to be stratified horizontally above Stellenbosch, and form detached masses of rock, that have descended to the valley; they seem to be sandstone.

The town of Stellenbosch is well watered; the streets are handsome, and run in straight lines like those of Cape Town. The houses are white-washed, and most of them are thatched with a reed, which, in its dry state, has a peculiar and disagreeable smell, somewhat resembling that of raspberry vinegar. The oaks with which the streets are lined and agreeably shaded, are in general of a good size. The two largest which we saw were before the house of the Landroost, one of them measuring twenty feet in circumference near the ground. The oak of the Cape grows about twice as fast as in England. Cuttings of it readily take root, and most of the fences are made of it. Excepting the fir, scarcely any other tree is to be seen. The wood, when well seasoned, is serviceable timber. Its bark is used here in tanning, and it makes good charcoal. The acorns, which it produces in great abundance, are uncommonly large, and are gathered and sold for fattening pigs.

We slept two nights at Stellenbosch, and the second day was spent in paying a visit to the village of the Paarl, which is about sixteen miles distant. We travelled over naked hills, consisting chiefly of decomposing granite. Here and there we saw pretty extensive corn farms, but without inclosures, and the ground was in general covered with heath. The Paarl is a neat, long, straggling village, built along the course of a rivulet, and derives its name from a rock, somewhat in the form of a pearl, that stands on the top of a hill below which the village is situated. The whole of this hill, which may be about six or seven hundred feet above the valley, is composed of granite, while the higher mountains on the opposite side of the valley seem to consist chiefly of sandstone. From being much sheltered, the Paarl is much hotter than Stellenbosch, and is considered nearly as hot as Cape Town. Its fruits are particularly good. It yields abundance of grapes, and the vines are considered among the best which the Cape affords. The soil is a reddish loam, derived from the decomposition of granite.

Our excursion to Hottentot Holland occupied three days. We were hospitably entertained by Mr. T. an opulent Dutch farmer, at whose house we stopped. His house is beautifully situated in a grove of fine trees, chiefly oaks, beside a running stream, and at the foot of lofty sandstone hills, with an opening through the trees, commanding a view of a good part of Table Bay, and the whole of Simon's Bay. The house itself is substantial, spacious, and well furnished. Before it, in the garden, are a few very large camphor trees, planted a little more than 100 years ago by a Dutch governor, to whom the place belonged. Mr. T. has about seventy slaves, and amongst them workmen of all kinds that a farmer leading such an independent life requires. He not only grows the food which his family consumes, and grinds the wheat he raises, but he makes his own waggons and farming implements, requiring to purchase nothing but clothes and foreign luxuries. Mr. T. though in the prime of life, is a grandfather, and the father of sixteen children. His table at dinner groaned under a weight of provisions. According to the Dutch fashion, spices were mixed with the vegetables, the potatoes and the dish of cabbage being sprinkled with nutmeg.

The day on which we stopped at Hottentot Holland we spent in visiting the Kloof, about six miles distant. Mr. T. drove us to the foot of it in his eight-horse waggon. We passed several good houses, extensive gardens and vineyards, and many corn fields, which impressed us with a favourable idea of the productiveness of this part of the country, and of the wealth and comfort of the proprietors. A new church was pointed out to us by Mr. T. with evident satisfaction. He was one of a few neighbouring wealthy proprietors, who built it out of the profits of a large farm in lots, which they had purchased entire.

At the foot of the Kloof we left our horse waggon, and got into the common ox waggon. As the road over the Kloof is the great road into the interior, and as the heavy toll of a rix-dollar is levied on every waggon that passes, there is no excuse for its badness. It is very narrow, very steep, and very rocky, and is for some distance cut through clay and decomposing clay slate. The ascent, and particularly the descent, of this Kloof is attended with some danger. Many waggons have been dashed to pieces on the precipices at the road side, so that travellers always walk both in going up and coming down.

In ascending the hill we had a fine view of the peninsulas of the Cape of False Bay, of the flat sandy country between the two seas, and of distant Table Bay. We looked down on the little, rich district of Hottentot Holland, or as it has been lately called, Somerset, spotted with white cottages and substantial farm houses, in the middle of vineyards, gardens, and groves.

From the top of the Kloof we had a pretty extensive prospect inland, over a high, hilly, rocky, and naked country, bounded by pretty lofty mountains. Nothing could be more dreary than this view. I did not perceive a single house, nor indeed any cultivation; no flocks, no herds, and no traces of man. The country, however, is said to be less of a desert than it appears, some of the favourable situations being inhabited and cultivated.

Mr. T.'s house may be about thirty or fifty feet above the level of False Bay. At 7 A. M. I observed my barometer at 30$^{\text{in.}}$.15, the attached thermometer at 72°, and the detached one at 72°.5. At 11 A. M. I suspended the same instrument to an overhanging rock at the top of the Kloof, where it stood at 28.8 inches; the attached thermometer being 75°, and the detached one 73°. At 11$^{\text{h}}$ 30′ it was at 28.755, the thermometer being 74°. Taking this last measure as the best, the height of the top of the pass above Mr. T.'s house is 1319 feet. This Kloof or pass is in the lowest part of the chain of mountains that may be said to bound the interior. The dreary country between the first and second chain is nearly as elevated as the Kloof itself, for the descent on that side is very inconsiderable.

In ascending from the Kloof, a good opportunity is afforded of viewing the rocks of which the mountain is composed. The bottom of the Kloof is granite, in common with the low hills beneath. About one-third of the way up, the road is cut through a soft decaying clay slate of a light ash-colour, and about half-way up sandstone makes its appearance. Where the two rocks approximate, the sandstone appears to be a mixture, as it were, of particles of clay slate, and siliceous sand, and a hand specimen of it would be called grey wacke. The ridges of the mountains, and the whole upper part of it, is formed of siliceous sandstone. It is very remarkable, that the strata of the rock on each side the Kloof are very nearly vertical, whilst in Table Mountain and Lion's Head, they are very nearly horizontal. In consequence of this position, the forms of the rocks on the ridge are very strange; the ends of the stratum sticking up, and presenting an irregular, broken surface. On the very top of the ridge, I found quartzy pebbles imbedded in the rock, and in cavities of the same mass, I found transparent crystals of quartz, some of which were half an inch long. It is worthy of remark also, that, in several large masses of the sandstone there were stripes of opaque quartz, which had a slightly opalescent appearance.

In the neighbourhood of Cape Town, there are various geological appearances worthy of notice. The first of these is the junction of clay slate and granite, which presents itself in the ravine which is observed in ascending Table Mountain; the rocks being laid bare by the descending rivulet. The granite at the place of junction penetrates in many places into the slate, and the veins are of different lengths and breadths, the largest being about a foot wide. The vein stone is a much finer granite than the mass. Fragments of the slate are sometimes included in the granite, and in one of them, which is about a foot wide and two feet long, the peculiar slaty structure of the clay slate is very obvious, and the inclination of the slate in the fragment does not coincide with that of the adjoining strata. These phenomena appear very favourable to the Huttonian system.

The second geological fact is a junction which takes place under the western extremity of Table Mountain, the very extreme point which bounds the view from the town, and opposite to the Lion's Head. It is nearly 500 feet higher than the preceding, and about 1500 feet above the sea. This junction is of granite with clay slate, and of clay slate with sandstone.

The granite of which the Kloof and the lower part of Table Mountain consists, as well as the greater part of Lion's Head opposite, is only separated from the sandstone, of which the top and perpendicular sides of the mountains are composed, by a thin stratum of clay slate; judging from the partial manner in which it is exposed, not more than two or three feet thick. The slate is of a red colour, as if heated. It contains a good deal of mica or small scales, and is very friable, separating readily into laminæ. The sandstone lying immediately over the clay slate, has also a peculiar character resembling that of opaque quartz more than sandstone. The structure of the latter, indeed, is not to be observed in it. Portions of it exhibit a structure slightly crystalline. The more distant it is from the slate, the less quartzy and crystalline it appears; and it is also remarkable that though the sandstone immediately over the slate is so compact in its substance, yet masses of it are very friable, and are full of cracks as if strongly heated. Judging from the thin layer of the slate, it appears to be conforming to the sandstone strata, which are almost horizontal, dipping only a very little to the east.

The third fact is a junction of granite and clay slate, which occurs under Lion's Head on the sea shore between the bottom of the Kloof and Green Point. Along the shore, on one side, the rocks are of slate in almost vertical strata. On the other side, towards the Kloof, they consist of large masses of granite. Both rocks are continued into the sea.

Where the slate approaches the granite, it is unusually hard, has rather a crystalline structure, and contains a good deal of mica. Many veins of granite run into the slate, and many fragments of slate appear to be included in the granite.

In seeking for information respecting the rocks of the colony, I have learned from Colonel Bird, secretary to the government, that white marble occurs in the Sera field or Albinia, where the emigrants from England are to be stationed. I have seen specimens of agate from the bed of the Orange River, and it is probable that there are floetz rocks in that quarter. I have seen a specimen of rock from the Compass Mountain below the Snow Mountains, which resembles primitive greenstone. It is said that near this mountain the compass does not traverse. A good deal of galæna is said to be found in the interior, and some copper, a specimen of which contained a very little of carbonate of copper. Iron ores have been found in many places. In Hottentot Holland Kloof, I saw a considerable mass of red iron ore approaching to Hæmatite, but I have heard of no meteoric iron.

The story of the anchor on Table Mountain is well known, and of the same character is another about the keel of a ship found in the sand many miles inland under Tigersberg. According to Colonel Bird, this supposed part of a ship is nothing more than the remains of trees buried there, the wood having acquired a dark colour, and being impregnated with iron pyrites. The fertile soils of the Cape appear in general to be over granite, and to be derived from its decomposition. They are commonly light loams. I have nowhere seen a stiff clay soil.

The peculiar flavour of the Cape wines has been ascribed to a clay soil; but this is not probable, as the vines of the Paarl are considered to be the best, and yet the soil is there more clayey than usual. The soil of the Constantia vineyard is a light loam (of red sand) derived from granite. The chemical nature of the soil has probably less influence than its mechanical state and its exposure and situation. Colonel Bird mentioned to me a confirmation of this opinion, that the vineyards exposed to the morning and midday sun afforded better wine than those which enjoyed chiefly the afternoon sun. One of the principal causes of the disagreeable flavour of Cape wines seems to be, that it is not kept a sufficient length of time.

According to a writer in the Quarterly Review, the hair of the Hottentot is not woolly but harsh and wiry. I have now before me a sample of the hair of a Boshesman, of a young Hottentot woman, and of a Caffre boy. The two former are completely woolly, in little ringlets, plaited by tufts. The latter is rather between woolly and curly.

The stature of the Caffre is about five feet ten inches, and he is cleanly and finely made. His forehead is high and open. His eyes are round, large, and animated. His cheek bones project a little. His nose is rather flat, and the alæ rather expanded. His lips are full, his face oval, and his colour is a dark chesnut brown. The climate of Caffraria is rather colder than that of the Cape. Ice has been sometimes seen there by Colonel Bird. The colour of the Hottentot is a light brownish yellow, and his face is remarkably angular. The colour of the Boshesman is a light dirty yellow.

In the last two races, what we considered the peculiar African features are more strongly developed than in the Caffre, although they are much fairer.

I am informed by Colonel Bird, in opposition to the opinion of Colonel Hartly, that he has always observed, without a single exception, the barometer to rise before a north-east wind.

ART. IX.—*Notice respecting the Boilers of Steam Engines.* Communicated by the Author.

THE numerous and fatal accidents that have taken place by the bursting of the boilers of steam-engines, have led to many proposed improvements and alterations in their construction, in some of which much ingenuity has been displayed; and yet after all those attempts to improve them, we continue to hear occasionally of disastrous consequences from the same cause. The writer of this article was therefore led to consider how far it would be practicable to work steam-engines with a small boiler; and his first idea of effecting this, was to make a large flat and truly circular ring of iron, to be gradually moved round by means of the steam-engine upon horizontal rollers somewhat conical, and to be kept in the same circular space by perpendicular rollers, so placed round its outer circumference, as to allow for the expansion of the ring when hot. This iron ring was to pass through a segment of a circular tube of sheet copper, of a radius corresponding nearly with that of the ring, and having no more space in the inside than sufficient to admit the ring to move in without rubbing. The copper tube was to be introduced into a strong steam vessel of the same length with it, by holes cut in the ends of this vessel corresponding to the end dimensions of the tube; the ends of the tube to be fixed steam-tight into the ends of the vessel, at the same time leaving the ends of the tube open for receiving the iron ring; the iron ring being so made as to be put in or taken out at pleasure. The copper tube was to be placed at a short space from the bottom of the steam vessel, and the dimensions of the vessel in other respects to be such, that there should only be a short space between its sides and the copper tube; but that the top of the vessel should be of a requisite height above the tube. Into the top of this vessel a steam pipe was to be introduced, for conveying the steam to the cylinder of the engine. A forcing pump was to be wrought by the engine, to convey water from the hot well into the steam vessel; and with a view to prevent the copper tube from being at any time too deeply covered with water, a second pipe was to be introduced into the top of the steam vessel, so as to reach down to the height that the water ought to stand at. This tube was to have a ball cock, to admit the water being forced out by the steam when it rose too high. The upper end of this tube to be continued to the hot well of the engine, where it discharged the waste water. An air furnace was to be built near one end of the steam vessel, and a flue that could be removed at pleasure to be carried round from the furnace immediately over the iron ring, in such a manner that at least three-fourths of the ring should receive the heat both of the furnace and flue. It was further proposed, that the pipe leading from the hot well and forcing pump to the steam vessel should pass through the furnace fire, and along the flue.

In the annexed sketch, Plate IX. Fig. 1. *a a*, *a a*, *a a*, *a a*, represent the large flat iron ring; *r s*, *r s*, *r s*, &c. the horizontal rollers; *t*, *t*, *t*, *t*, &c. the perpendicular rollers; ABCD the steam vessel; *x x x x* the copper tube; EFG the furnace; the dotted circles G *s*, *t s*, *t s*, &c. and F, *r*, *r*, *r*, &c. the flue; P that part of the flue that leads to the chimney; S the steam pipe that leads to the cylinder; *u v*, and *x y*, parts of the induction pipe that supplies the steam vessel with water; R the ball cock; W its waste pipe; and T an escape valve.

The method proposed to prepare this vessel for action was as follows:

1*st*, To disengage the apparatus that was to be connected with the engine for gradually turning round the great iron ring; 2*dly*, To kindle the furnace fire; 3*dly*, To fill the hot well of the engine with boiling water, which was further to be heated by the induction pipe passing through the fire and along the flue, so that the water should enter the steam vessel nearly boiling hot; and *lastly*, To continue to turn round the iron ring gradually, by working with the hand the apparatus that was to be placed for moving it round by the engine, until the ring was of a heat sufficient to raise steam to work the engine.

The principal properties that this scheme appeared to possess, were 1*st*, The smallness of the steam vessel required for raising the steam, which consequently might have been made of any required strength; 2*dly*, The great iron ring, when once brought to the required heat, might have been kept at that heat at a small expense of fuel, owing to the ring not coming into contact with the water; and *lastly*, The ring might be said to be a reservoir of heat, the ring not being liable to consumption like a fire of combustible matter.

But before finding it convenient to bring the above scheme to the test of experiment, a superior plan occurred; and in 1823 a model of it was fitted up, and experiments made in presence of several in the immediate neighbourhood, and at last in presence of two ingenious mechanics, who were invited to witness the rapid production of steam without the aid of a boiler. The plan appeared to them very simple, and secure from danger; and the experiments so satisfactory, that they have commenced mounting a high pressure engine upon this plan without a boiler, and of a power sufficient for their own works; and indeed several of the principal parts are already executed in a superior manner.

If, when finished, it work equal to my present expectation, a description of the engine will be sent for insertion in the Edinburgh Journal of Science.

July, 1824. A. S. O.

ART. X.—*Account of a Map of the Kingdom of Pegu.* By FRANCIS HAMILTON, M. D. F. R. S. &c.

THE accompanying map, Plate X. was given to me at Ava by the slave of the king's eldest son, whom I have so often mentioned. As this part of the empire is better known to Europeans than those more remote from the sea, it may enable the reader to judge how far reliance can be placed on the accuracy of the compiler. In justice, however, to him, it must be observed that he did not pretend to be well acquainted with the part of the country here delineated; and, although he had passed repeatedly from Ava to Rangoun, and from thence to the frontier of Siam, he was little acquainted, except by report, with the greater part of this territory, far removed from the seat of government.

The part in which the most flagrant errors have been committed is on the west, quite out of the line of the military operations, in which the slave had attended his master. Here, indeed, the map ends abruptly, without bringing the hills of Rakhain (Modæntaun) down to Modængarit-bhura, a celebrated temple at Cape Negrais, or without bringing the western branch of the Erawadi to the sea, so that from sixty to seventy miles square have been curtailed; as by this means the true situation of Negrais Island (Haingri Kiun) and of Persaim (Pasein) has been cut off; and, as both are places of consequence, they have been moved east to the principal channel of the Erawadi, which in Arrowsmith's map of Asia is called the Barago river. The western channel (Anaukkhiaun) of the Erawadi leaves the great river eight or nine miles above Hænsada; although in this map it is laid down as if it separated at that town, having Kiaun Zheip on the opposite bank. So far, however, as I could observe in passing, both Hænsada and Kiaun Zheip, two places then flourishing, and extending a great way along the bank, are situated on the south side of the channel, which indeed I saw behind Kiaun Zheip; but it is very probable that this town may be on an island, and the principal channel may be between it and Hænsada. This branch is called Anauk Kiaun, or the western channel, and in the dry season it contains little water, and therefore is not dignified with the name of Mrit. It is also called Kiudowa, I believe, from the name of a village near its upper end. From thence the Modæn, or Modæn Garit hills, separating Pegu from Arakan, are visible, although they appear to be of no great height; but all the country south and east from that is a dead level. The Anauk Kiaun, according to this map, rejoins the great river before this reaches the sea; but sends a branch farther west, on which in fact Pasein is situated, about seventy miles from the sea, and so far ships can reach; but beyond it the channel is not navigable in boats of any size, or for floats of timber, except in the rainy season, and even then with difficulty; as a Mr. Burns, who commanded a ship trading there, informed me, that in the month of September it took him three weeks to go from Pasein to Prin. This channel on which Pasein stands, is called Pasein Mrit, as at the town it enlarges into a great estuary, well delineated by Mr. Dalrymple; but higher up it is called Ngawun Khiaun.

The west bank of the Erawadi, from Hænsada to Talouphmio, where the ancient kingdom of Pegu ends, was thriving when I visited it, and was the most populous country in the empire that I saw; for besides Hænsada and Talouphmio, both considerable places, I saw Shue Giæn, where gold is found in the sand; Kanaun the lesser and greater; Mranaun, formerly called Loonsay, the largest place that I saw in the empire except the capital, and Kianghæn. As none of these places are mentioned in this map, we are not to form any idea of the number of towns from what it represents.

Opposite to the lesser Kanaun, I saw at Regæn the northern point of the delta of the Erawadi. The channel, which forms the eastern boundary of this delta, divides into several branches, on the farthest east bank of which stands the city of Pegu or Pago, while a chain of hills running behind Sarawadi, and visible from the upper point of the delta, and from the city of Pegu, forms the northern boundary of the kingdom, of which this city was the capital. These hills, where I saw them at Prin, consist of sandstone and limestone rising in flags; and I understood from good authority, that they contain springs, from which culinary salt is prepared. Only a small part of the remarkable plexus of rivers, laid down by the native of Taunu to the north and east of this channel, (*Phil. Journ.* v. 76,) is included in this map; but, so far as it goes, it supports, in a remarkable manner, what the native of Taunu has delineated; only the slave seems to have given the courses of the different rivers with most accuracy, although both no doubt are very imperfect.

There is one circumstance relative to this plexus of rivers, concerning which the information that I received was very far from satisfactory. I am not fully assured that any water enters from the Erawadi into the channel, which I have considered as forming the eastern side of the delta, and which I know, where it joins the Erawadi, is not navigable in the dry season. It may very possibly be, that the water from the plexus enters the Erawadi at Regæn; so that the water of the Sarawadi, in this map called Ramari, divides into two branches, the one running west to the great river, and the other south by Lain and Pago. The Sarawadi, in the rainy season at least, is very considerable, and brings to market the greatest quantity of teak timber that comes to Rangoun; and its branches, the Lain Bauk, the Awa Bauk, and the river passing Pegu, are all of some size where I saw them, being perhaps as large as the Clyde at Glasgow, all receiving the tide to a considerable distance. The Sarawadi derives its name from a town so called in the Pali language, which in the vulgar dialect is called Mængri; and, when I was in Ava, was held by the queen for her aliment.

Should it thus appear that the channel at Ragæn falls into the Erawadi, and does not separate from that river, the head of the delta must be considered as situated about eight miles above Hænsada, or about 145 geographical miles from Cape Negrais. In this case, the eastern boundary of the delta, formed by the main channel of the Erawadi and the Rangoun branch, will be about 113 geographical miles in length, while the width of the basis between Cape Negrais (Modæn Garit) will be about 185 geographical miles. That this is the real extent of the proper delta of the Erawadi, may be inferred from the names of the rivers bounding it. The branch separating above Hænsada, as I have said, is called the Anauk Kiaun, or western channel; while that going towards Rangoun at Rangæn Zanra, is called Ascicæ Giaun, or eastern channel; and the continuation of the great river to the sea is called Alæ Giaun, although it is also called Baranasi Khiaun, and Pantano Mrit, from the former of which the name Barago, used by Arrowsmith, seems to have been derived. This direct and principal channel of the Erawadi, like that of the Ganges, probably from both subdividing much before they enter the sea, does not afford access to shipping; and the only harbours that are accessible are at the extremities of the delta.

Between Hænsada and Dhanubru I saw the two channels leaving the great middle branch of the Erawadi towards the west, as laid down in this map; and between them a small village, which is the port of Lalu; for this town is a Mranma league from the river, and is celebrated for a temple of great sanctity. In 1795, this government was in possession of Mue Bhura, a favourite lady of the kings. Dhanubru is a straggling place without any temple of note, but contained three or four hundred houses.

I have already mentioned the great error in this map, of laying down Pasein on the principal or central channel of the Erawadi; and there are other difficulties attending the same vicinity. In returning down the river I was informed, where the eastern channel separates from the great river, that the latter bounds on the west the government of Dala, the provision settled on Mredo Bhura, the queen's mother; and we were told that the custom-house on the southern side of the eastern channel belonged to this lady, whose estate was said to include the whole triangle formed by the eastern and central channels and the sea. I was also told, that Pantano was a considerable town and government on the western side of the central channel; but in this map we have Pantano and Samraendaum laid down in the territory which should belong to Dala; while this place is laid down near Rangoun, instead of being on the channel between Panlain and the sea, as I was informed at Panlain. I therefore suspect that Dala should have been placed where Pantano stands in this map, and Pantano at the town below Dhanubru, which has no name; and this will explain why the river next the Barago in Arrowsmith's map is called Dolle.

From Dala, a creek proceeds west to join the central channel, and the most usual route by water between Rangoun and Pasein is by Panlain, Dala, and this creek, which is not noticed in this map; but has been delineated in that by the native of Taunu, (*Phil. Journ.* v.) where Samraendaum seems to be more properly laid down in the territory surrounded by this creek, the Dala, and the Barago, or Baranasi; and therefore in this map Samraendaum should have been placed a little west from where the compiler has laid down Pantano.

This territory, between Panlain and the great river, is most terribly plagued by musquetoes, and is the place most infested by this insect that I have ever been in. Even Calcutta is comparatively free from this annoyance.

The whole government of Dala is much intersected by creeks, through which the tide flows, but which have not been noticed in this map. No less than three creeks join the Rangoun river from the west, between the sea and the mouth of the Pago river. The one next the sea has three fathoms water at its east end. How far it carries this depth I cannot say; but there is a passage this way to Pasein, as I was told by the master of a ship who had made the voyage, and he was nowhere more than twelve miles from the sea. By the way he saw only one village; but farther north the delta is better cultivated, and there are many villages and immense rice-fields on the banks of a creek, which passes from Maindu, the town opposite to Rangoun, to the old town of Dala; and from thence to Pasein. According to some, this creek carries a depth throughout of twelve feet, at least for a considerable part of the tide, so that vessels of this draught of water may pass the whole way, although at low water they may be in some places aground. Others allege, that it is navigable only in the rainy season. I went upon this creek, which is called Kama Haun, entering it with the flood tide, which was strong, and proceeded for about three miles. There I came to the town, named Kama Haun, or old Kama, which is probably the place which in this map has been named Dala, as the real Dala has been named Pantano, and as the real Pantano has been left without a name. Kama is on the south side of the creek, and a branch goes there off to the south, while another proceeds in the same direction about half way between Maindu and Kama; so numerous are the channels in this part.

The great province of Hænsawadi, so far as I could learn, is bounded by the Rangoun river and sea on the south, by the Zittaun or Paunlaun on the east, by the Ruanuæ on the north, and by the Ramari or Sarawadi, and Erawadi on the west. It is divided into thirty-two districts, of which only six, Rangoun, Pago, Zetowadi, Sanliæn or Sirian, Lain, and Awain, are laid down in this map.

Near the sea, the creeks or channels forming the plexus of rivers in Hænsawadi, are fully as numerous as in Dala. No less than four creeks proceed to the east, between Sanliæn and the sea, although the great temple Kiækkauk stands on the west end of a low ridge of hills; and even the eminence on which Shue Dagoun, near Rangoun, stands, although its foundation is rock, is surrounded by a creek, the Kasma Khiaun, which runs from Awa Bauk to the Ngamure Khiaun, immediately east from Rangoun. In the month of November I went about a mile and a half up the Awa Bauk, a large channel with strong tides. The water at low ebb was quite fresh; but at the height of flood was a little brackish. While in so small a space so many creeks exist, that are not noticed in this map, we may readily guess at the great numbers that must be included in the whole plexus.

Between the eastern boundary of Hænsawadi and the Saluæn the plexus of rivers is continued; and although there are some slight differences between this map and that published in the fifth volume of the Edinburgh Journal, and drawn by a different person, yet the agreement both in the rivers and hills is very considerable, and sufficient, in my opinion, to give a great degree of confidence in the general accuracy of the two draughts, making a proper allowance for the rude nature of the execution. This map evidently has the advantage in execution, as well as in fulness of detail, but includes only the four insulated spaces between the Zittaun and Taunwæh, or Taunwain rivers, that are next the sea. Opposite to these spaces, the Taunwain river is represented in this map as receiving from the eastern hills four streams, besides the two creeks connecting it with the Saluæn, which are common to both maps; but in the map formerly published only one of these mountain streams is noticed. In clear weather, the mountains east from Zittaun are visible from the great temple Shue Modo at Pago, running far to the north, and are therefore of considerable elevation, as they no doubt are at a great distance.

Mouttama, or Martaban, is certainly the most important government in the kingdom, extending for a great way to the frontier of Siam; and as Dawæ (Tavay) and Breit (Mergui) in 1795 were governed by two lieutenants (Zikkæh) of its viceroy, (Mrowun,) we may believe that all the other towns towards the Siamese frontier were in a similar condition. But in this map there is no attempt made to delineate these parts, of which the compiler gave me at the same time a draught. The sea-coast, therefore, south from Martaban in this map, must be considered merely as a sketch, to show that there is a territory in that direction. Whether or not the province of Mouttama borders upon Hænsawadi I did not exactly ascertain. Some said that it did; while others said that the hills east from Zittaun formed the western boundary of Martaban. In this case, Zittaun and Sathoun must be independent of either viceroy, and in this case are probably held in fee for service, as I heard of no other viceroy in these parts. I saw the viceroy of Martaban at a public entertainment given by the viceroy of Hænsawadi. He was treated with the greatest respect, and took no notice whatever of the British resident, who was considered as a very inferior personage. This was not consonant with the ideas of ambassadors long entertained in Europe, and now adopted in India, and showed a silly pride and want of urbanity in the government of Ava; but was probably by no means intended as an insult. The embassy was under the charge of his brother viceroy, and any notice taken of it may have been considered as interfering in another person's affairs.

Art. XI.—*Observations on the Wheels of Carriages.*[*] By JAMES WALKER, Esq. F.R.S. Ed. Civil Engineer. Communicated by the Author.

The received theory of wheel carriages has always been at variance with practice. Philosophers have not even agreed amongst themselves which is the best form, some recommending the dished or concave wheel; but by far the greater number the perfectly straight and vertical one, all agreeing that the axles should be at right angles to the pole or line of the shafts, and perfectly straight to the extremity of the arms, and that the plane of the circle of the fellies should be at right angles to the axle; or, in other words, that the plane of the rims of the wheels be vertical, and that the rims themselves be sections of cylinders, and parallel to the surface upon which they move. Yet notwithstanding the superiority which theory, supported by numerous sets of experiments, has thus given to the straight axle and the cylindrical rims, the bent axle and the tapering rims have been, and still continue, with every appearance of determined obstinacy, to be almost universally used in heavy as well as light carriages; but more particularly in the former, where one would suppose that the effects of so great an error must be most sensibly felt. Figures 5. and 6. Plate IX. are skeletons of the two recommended forms, and Fig. 7. that of the form which has been so universally reprobated. They are supposed to be placed upon a horizontal surface, and convey a more distinct idea of the differences than is done by the description.

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[*] The following able article contains the substance of Mr. Walker's examination before the House of Commons on the subject of the Highways of the Kingdom, which is now printed for the first time.—Ed.

A reverential adherence to old customs, has been a most powerful agent in retarding the progress of improvement; but the love of novelty is opposed to it, and it is perhaps equally powerful as well as general; and we need go no further in search of the proof of this, than to observe the changes that are constantly taking place in the fashions of the springs, the body, and almost every other part of carriages themselves. Yet during all these changes, this power of novelty has never been able to introduce into general use the cylindrical wheel or the straight axle, though recommended by every writer upon mechanics generally, and upon wheel carriages particularly, and having the sanction of all reports and inquiries, (so far as I know,) in their favour. This opposition is the more remarkable, as the owners of carriages are so immediately interested in lessening the labour of their horses, which is held out as the certain effect of the recommended alterations; so that a deeply rooted prejudice and a blind opposition to their own interests, and to the interests of the public, would appear to be the only motive to which their conduct can be ascribed. Before, however, drawing so dishonourable a conclusion, it may be worth while to examine if there is any more creditable way of accounting for this universal resistance to the recommended changes; and if in doing this I appear to oppose my opinion to those who have been better qualified to judge, I beg to premise that I do so, not from a fixed determination in my own mind as to what is upon the whole the best form, for I have not been able to give the subject so much attention as to presume to do this; but as the honourable chairman of this committee requested me to turn my attention to the principles of wheel carriages, as connected with the inquiry respecting highways, I think it right to state the ideas that have occurred to me, which may not be the less acceptable if they differ from those of others; and the utmost I expect, or have been able to satisfy my own mind of, is the propriety of delaying any parliamentary enactment in regard to many of the points in difference, until the question is still more fully considered, and experiments made upon such a scale as to remove all doubt as to their correspondence with what they are meant to represent.

Mr. Cumming, in his essay on wheel carriages, states, that he can discover no good quality which the bent axle and the conical rim possess, and he accounts for their introduction by supposing that the first wheel carriages were made narrow, on account of their small burthen, and of the narrow roads, and that a track being thus formed, the wheels of larger carriages were made to fit the old track, by throwing them out, or making them wider at the top only, which inclination of the wheel was effected by bending down the arms of the axle; and that the rim was then made conical, to give it a bearing for its whole width. I have thought that the conical form might be accounted for in a different way, without giving the inventor much greater credit, by supposing that they were first made with a straight axle to fit the roads and streets, of which the gutter was in the middle, and the sides sloped into it. See Fig. 8.

Neither of these histories of its origin will, however, account for the continuance of a system so long after the causes which gave rise to it are at an end; nor do I think that its defence is confined to such untenable ground, or that it is difficult for the apologist of the bent axle and conical rim to show that they have from reasoning or from experience been introduced as intended improvements upon the plans which philosophers have themselves advised.

The first question for examination is, which of the two recommended plans, viz. the straight or conical wheel, is entitled to a preference.

If a road could be made so perfectly smooth, and the motion of the carriage upon it so regular and gentle, as to remove the possibility of all shake, and tendency to strain in a lateral direction, then the straight wheel is undoubtedly the best, because the power of the spokes of the wheel to oppose such a pressure is greater when they are perfectly upright under their load, and because the joints being square, can be made with greater ease and accuracy than level ones. Therefore a model, the finely turned wheels of which are intended to be drawn upon a smooth board, had better be made in this way, and for the same reason the model of a wooden cottage will be found quite stiff enough for standing as a toy upon a table, although all its timbers are in the same way framed in vertical and horizontal lines, but the builder will find his error if he follows this model in the erection of the cottage itself; it must be both very low and very broad upon its base to be found with upright sides and unmoved joints after the first breeze of wind; if high, it will vibrate under its own weight,—it wants bracing; and, therefore, the largest timbers in such a building are often the diagonal ones, of which the use is not so much to bear weight, as to keep the building upright by opposing a resistance to the lateral strain. Now, the straight wheel is evidently deficient in this respect, it has nothing of the brace or diagonal in it; and if bracing be necessary for a building, which is comparatively a body at rest, it is not to be expected that a loaded cart or waggon moving over rough roads, and touching the ground upon two or four points only, can be stiff enough without it; and experience has, I believe, uniformly proved that wheels so constructed soon get loose at their joints, that the whole wheel gets crippled in consequence; and that, for durability under heavy work and rough roads, such wheels will not answer the purpose. This weakness is evident, when we take the carriage as moving upon a horizontal surface; but will be greater and much more apparent if we suppose it to be moving upon the inclined side of a road, (Fig. 5.) when the greater part of the load is thrown upon the lower wheel, and in such a direction as is evident from the line of gravity, (*a b*) as to tend to bend in the lower wheel under the load. Hence it is that the upright vertical wheels become convex outwards; and the tendency this way from the above cause is so great, that even when the wheels are made dishing or concave, it is difficult to preserve them in that shape, their tendency is to become straight, and if an old wheel is looked at, it will be seen by examining the mortise that the spoke has moved in that direction; and in setting new wheels the workmen always make an allowance for this tendency.

This want of bracing in the straight vertical wheel, Fig. 6, is in a great degree remedied by the dished wheel Fig. 5, the dishing or sloping of spokes evidently acting as diagonal braces, forming the axle and the spokes of the wheel which bear upon the ground into a trussed frame to resist a lateral motion. The frame ABCD, Fig.10, has nothing in it to resist a racking or lateral movement; but if we remove the uprights AB and CD, and substitute EB and FC in their places, we shall lessen the power of the frame to bear a vertical pressure, but shall much improve its general use, by the brace which we have given it; and the application of this principle to the wheels Figs. 5 and 6 will be easily seen. But although in point of bracing Fig. 5 is better than Fig. 6, it again is inferior in point of strength taken vertically. The upright is the strongest position in which a post can be placed to carry a dead weight, and a small angle produces a great decrease in the strength, which cannot always be afforded, for when one of the wheels of a heavily loaded waggon rises over an obstacle in the road, or sinks by a sunden jolt into a deep track, the momentum it has to resist is very great, and should be met by a perpendicular, or nearly so, or the spoke will be apt to be broken by its weakness. Thus each of the recommended wheels has its disadvantages; and if in practice the carriage is subject to them in any degree at all considerable, it is unfit for its purpose. This want of bracing or of strength has probably never been felt in experiments with models, for the reason I have already stated; and even were the model moved upon a proportionably rough surface, its weakness would not probably appear, because the waggon and strength of its parts, when extended to full size, increase in the ratio of the square, while its dead weight increases as the cube. Thus, a model made to a scale of three inches to a foot may be found perfectly secure;

but when we extend it to full size, which is only four times the scale, we increase the strength of the timbers 16 times; but we increase the weight of the machine at the same time 64 times; that is, we give the parts which have to support the weight four times the load to carry in proportion to their strength which they before had; and we might extend our scale until our heavy waggon had load enough in bearing up under its own weight. (This principle it is which sets a boundary to the strength of all animals, of man himself, as well as of his works, and renders a small animal or a small waggon stronger in proportion to its weight, than a large one.) The desideratum, therefore, is to combine strength with stiffness, or to connect a vertical pressure upon the ground with a dished or braced wheel, in order to give strength and firmness to the carriage. This has been tried by making the spokes of the wheel a brace within themselves, by fixing them alternately into two different lines in the nave, the vertical line to the felly being between them, so that the spokes form braces to each other. This plan has an additional advantage, that the stocks are less weakened than when the mortises are in one line round it, and carriage wheels, of which the circumference of the stock is but small, are generally made in this way; but a very long stock is required in order to give the spokes much of an angular direction, and when they deviate much from the perpendicular they become liable to the same objection as the vertical dished wheels.

Let us, therefore, try another way, and beginning upon the horizontal surface *a b*, Fig. 7, lay upon it the flat rim and felley *c*, into which mortise the upright spoke *d*. We have already obtained the best position for the bearing upon the road and for the vertical pressure, but we have made no provision against the lateral strain; and if we continue with vertical and horizontal lines, we shall be deficient in this respect. Let us therefore try to place the spoke *e*, which is opposite, or nearly, to *d*, at an angle to the latter, and with its felly perpendicular to itself, and if we then connect the ends of the spokes by the straight bar *f g*, we shall have formed the vertical section of each of the wheels into a triangle, which is a truss within itself, and the two wheels connected by the axle, and acting in contrary directions, form another trussed frame upon which a load will be supported and braced. This bracing to a certain extent will be evident by the inspection of this one section; but if we suppose the circle of the wheel to be completed, and bars *f g* fixed to each pair of opposite spokes, and crossing each other in the centre of the wheel, we shall very much increase the resistance of the wheel to a movement or strain in any direction. Still, however, our purpose is not completed; it is not enough that we have *d* perpendicular to the ground, unless every spoke in the wheel is so likewise; that is, unless when the wheel has performed half a revolution, we bring *e* to be upright, and *d* to be sloping, which in Figure 11 would not be the case if the arms of the axle were straight. This will be accomplished very simply by forming the wheel concave, making the obliquity of all the spokes to the stock equal, and then giving the axle an angle of inclination to the horizon downwards, equal to the angle which the dished spokes make with a vertical line; and I can see no other way in which the same thing can be done. The effect produced by this bend downwards will be easily understood by comparing the dotted lines of Fig. 12, which show the axle, &c. as bent down with the black lines which show the position of the different parts before this took place. But it may be said, and truly, that the straight bars *f g* will be both clumsy and inconvenient. They would so, but the tie formed by the tire of the wheel answers the same purpose more effectually; and, therefore, renders them unnecessary. The tire is circular; it is retained in that position by the radiating spokes and the angle which they form; or, in other words, the brace of the wheel cannot be lessened without the spokes getting more upright, which they cannot be until the tire is broken, for the same length of line in the shape of a circle incloses more space than in any other figure. It will be observed also from the inspection of the figure, that as the felly and tire are perpendicular to the spokes, the surface of the rim that is uppermost becomes more bent down by increasing the angle of the upper spokes, and that a new and important brace is thus gained from the angle which the opposite sides of the tire make with each other, by which a much greater resistance is offered to a change of figure inwards than if the sides of the rim were parallel to each other, or cylindrical. The form of a cask is a familiar illustration of what I have said: the hooping round keeps all the staves in their places more effectually than if they were held by bolts inside the cask, and the tapering shape of the cask gives a strength to it which a cylinder could not possess. Having thus endeavoured to form a wheel connecting the advantages of the upright and the dished wheel, and free from the defects of both, I find that I have discovered nothing that will entitle me to a patent, but that I have got back to the conical rim and the bent axle, in fact, to the wheel shown in Figure 7, which all manufacturers have been accused of ignorance and obstinacy in continuing to use in opposition to the demonstrations of science and the proofs of experiments. This form is besides attended with some other practical advantages worth noticing. From the wheels being thrown out at top, the rims of carriages coming in contact with each other in passing, meet in a very oblique direction, and unless they are so much within the line of each other, that the wheels get locked, the lightest of the two carriages is pushed off laterally, and the only damage may be the rubbing of the fellies upon each other, but were the axle lengthened out, so as to bring the wheels upright, the carriages would meet in opposite directions of the same line, and if they at all touched, either one of them must be brought to a dead stand, or some part of it, or of the harness must give way. It is to be observed also, that in light carriages the direction of the spokes has a tendency to throw off the mud which, if cast up in the straight line of the motion, would prove a great annoyance to the traveller; again, the direction of the wheel *fg*, Fig. 11, though forming an angle with a horizontal line, becomes more perpendicular to the surface when the carriage is upon the middle of a road that is raised and rounded towards the middle, while the upright and parallel wheels are in this case oblique to the surface.

We come now to consider the effect when the tire consists of one hoop of iron.—The effect of the continued wear of the tire, particularly when it consists of one hoop of iron, has a tendency to increase its length, for the same reason that a piece of iron is lengthened by constant beating upon it; now if the spokes be vertical and the tire cylindrical, the effect will be, that the diameter of the fellies cannot be increased without being drawn out from the spokes; and, therefore, either the iron rim will be loose upon the felly, or the spokes will be loose in the mortises, whereas in the dished wheels the only effect of an extension in the length of the rim is that the spokes become a little less dishing or more upright, to accommodate themselves to this additional length of the rim, which, by the by, is another cause of the spokes getting more upright by the wear.

Such appear to me the arguments in favour of the bent axle and tapering rims. They are perhaps fallacious, though I have been unable to discover in what respect; but as I have never before seen any thing written in their favour, and have turned my attention particularly to the subject only since your Chairman informed me of his wish to examine me respecting them, I would not have what I have said to be taken as orthodox without the inquiry which the subject deserves. Neither do I mean to say that the inclined conical wheels are free from the objections which have been made to them, that they increase the wear of roads, and the difficulty of draught, particularly when these observations are applied to broad wheel carriages, and when their tires are made to bear equally for their whole width upon the surface of the road, and I allow that all waggons ought to be made so, although but few if any are really so. I have represented the tire of Fig. 7 as flat, in order to avoid confusion, and because I consider any deviation from this as an evasion of the principle which may be practised under any of the plans. Fig. 13 is, however, the precise figure, from measurement, of the rim of the wheel of a six inch waggon as it comes from the hands of most of the makers, than which no form can be more destructive to the roads. Fig. 14 is the form of the same wheel after the rim has been worn some time. And Fig. 15 is the wheel of a new nine inch country waggon; all these are drawn to a scale. I have frequently remarked, that notwithstanding the supposed friction of the outer rim of conical wheels, by being dragged upon the road, I never could observe that this ring of the tire of a waggon was more worn than the inner, although they are both set originally at the same angle to the road; and the difference between experiment and experience is here to be noticed, as in some degree accounting for this. A model drawn gently along upon a smooth table moves forward without any shaking or irregular motion, and the drag of the conical wheel is very apparent, from the greater weight it requires to move it; but when a waggon is jolted and shaken upon a pavement or a road, the twist forward upon its axle to preserve the straight line, which is caused by the bend in that direction that is given to the set of the arms, so as to bring their front surfaces perpendicular to the line of motion, is obtained during these jolts, and the drag of the wheel and grinding of the materials of the road is much reduced. Mr. Edgeworth, though a strenuous advocate against the present system, compared a model of conical wheels, of which the inside diameter of the wheels was to the outside as 33 to 27, with a pair of cylindrical wheels, of which the diameter was as 34, and found that when upon smooth deal boards, the conical wheels required an addition of 50 per cent to the moving power to make their velocity equal to that of the cylindrical; but that when the experiment was made upon a fine gravel road in summer, the 50 per cent was reduced to 8; and that upon gravel stones, like a newly made coarse road, there was no perceptible difference between the cones and the cylinders, although the wheels were only eight inches high and four inches broad; that is, the breadth of the sole or rim was one-half the height, whereas the breadth of the wheels of a six inch waggon is only one-tenth of the height of the hind, and one-seventh of the fore wheel. The tire of coaches and light carriages is under two inches in width, and the taper or coning of the rims is so very small, that I doubt of the difference being perceptible under any circumstances. The tire of the mail coaches is only one and a half inch wide, and even in that width it is formed rounding; so that not so much as an inch in width touches the road, and the bend down or set of the arms of the axle is just such as to compensate for the taper of the arm, and to bring its lower surface to be horizontal. This property of the tapering arm is by the by worthy of attention, and shows that that shape is not deserving of the censure which has been thrown upon it, for by it the upper surface of the arm, which has no weight to support, is so inclined as to give the proper angle to the upper part of the wheel, while the lower part that bears the weight of the carriage, is in light carriages horizontal and perpendicular to the direction of the spokes which are under it. The width of the mails, including the tire, is four feet eight inches upon the ground, and five feet three inches at the top of the wheels, and the difference in chaises and light carriages is often less. The wheels are at the same time made considerably concave, so that the spokes which rest upon the ground have more inclination outwards from the perpendicular than waggons have, experience having taught the propriety of keeping the plane of the wheels (*f g*, Fig. 11) on account of the draught, as upright as is consistent with the strength and stiffness; and it is, I conceive, to this continued experience, and not to any *a priori* deductions of science that the present system of wheels which I have attempted to defend is to be ascribed. I cannot, however, but say, that famous as this country is for its machinery, I do not know any machine which, for a combination of lightness and strength, is superior to a well-built London carriage.

My opinion generally is, that any legislative measures should be confined chiefly to the width and flatness of the tire, and to the regulation of weights proportioned to the width of the wheels, as the only points in which the interests of the roads and of the coach owners can be much at variance; and I would extend this observation in many respects to heavy carriages, until better proof is given of the extent of the injury to the roads arising from the present shape of wheels, and of the other effects that may be consequent upon the remedying of that evil. The question is, whether by expelling the use of cylindrical wheels the reduction of the horse's labour and of the wear of the roads will more than compensate for the reduction in the strength and wear of the wheels. To assist in solving this question, a waggon might be made with cylindrical wheels on the one side, and conical ones on the other. The tire of the wheel that is best for the horses and for the roads would last the longest, and the difference in the wear of the frame of the wheels would at the same time be seen. Or a waggon or dray belonging to the same owner might be formed in each way, and care taken to send them out together, with equal loads, which might be done by the large brewers and others without any trouble or inconvenience. I have mentioned my opinion of the injurious effect of the present mode of forming the rim of the broad wheels, so that a small width only meets the ground; such ought not surely to be entitled to claim a reduction of tolls under the narrow ones, or to carry more weight than they do. They are equally injurious to the roads. The title to a reduction should be regulated by the width of flat surface bearing upon a horizontal plane, and a test for this might be fixed at the toll-houses, by bringing the wheels over a flat iron plate, and applying a proper wedge-shaped gauge to them when they are in that position. The large headed nails by which the tire is fixed to the fellies, are also very injurious upon gravel roads, when left projecting, as they usually are, from the surface of the tire, and it serves no good purpose to leave them so, unless to save the wheelwright the trouble of flattening them.

As the highways are important only as being the channels for communication by land carriage, the consideration of them involves questions equally important as the roads themselves; and I can easily conceive regulations which would be both oppressive and impolitic, although their immediate effect might be to lessen the expense of repairing the roads, and even to preserve them in better order than otherwise they could possibly be. The labour of horses for carrying a ton of goods for one mile, on the average of the kingdom, is not less certainly than one shilling; while the wear of the roads, judging from the tolls, is under one penny. As far, therefore, as the conveyance of goods is concerned, regulations which lessen the expense of the roads one one-half will, if they at the same time increase the horses labour only four per cent, really do no good; the toll would be reduced one halfpenny, and the horse hire increased one halfpenny per ton. Before, therefore, fixing such exorbitant tolls, or limiting the weight upon narrow wheeled carts and waggons in such a manner as would amount to a penalty for their use, both sides of the account ought to be fairly considered. From the great resistance which is made to broad wheeled carriages, properly so named, one is inclined to think that the draught of the horses is much easier with narrow ones. But to what extent is this? Is the difference of the wear of the roads greater than the difference of tolls? Or if all heavy carriages were made with broad wheels, would the general improvement in the roads be such as that in the course of time both expense would be saved in the roads, and the draught be easier than with the narrow wheels upon the present roads? On the average of gravelled roads, and when the weight is more than the fair load for one horse, I should be inclined to answer this in the affirmative; but my opinion is the result of general observation, and requires to be strengthened by experiments, conducted on a proper scale, and embracing both sides of the question.

ART. XII.—*Meteorological Observations, made at the Radcliffe Observatory, Oxford, in the years* 1822 *and* 1823. Communicated by the Rev. A. ROBERTSON, F. R. S. Savilian Professor of Astronomy at Oxford.

THE following is a table of the mean temperature of each month, for the years 1822 and 1823, obtained from a register of Fahrenheit's thermometer, taken at ten o'clock in the morning, and at ten in the evening.

	1822.	1823.		1822.	1823.
January,	40°	31°.4	July,	62°.1	59°.2
February,	42.7	38	August,	61.4	60.1
March,	46.4	40.8	September,	55.4	55.4
April,	47.4	44.7	October,	51.9	47.8
May,	55.5	55.2	November,	46.8	44.3
June,	63.6	58.6	December,	33.6	40.6

From hence we have the mean temperature of the two years as follows:

Mean Temperature in 1822, 50°.6.
Ditto do. in 1823, 47.5.

The quantity of rain which fell in each month, in the years 1822 and 1823, was as in the following table, the unit being an inch.

	1822.	1823.
January,	0.686	1.360
February,	0.942	2.645
March,	0.722	1.055
April,	2.097	1.873
May,	1.487	1.251
June,	0.305	1.166
July,	3.953	1.861
August,	0.120	3.314
September,	1.946	2.320
October,	2.394	3.470
November,	3.506	1.444
December,	1.083	2.870
In the whole year,	19.241	24.629

Mean quantity of rain for the two years, 21,935 inches.

The funnel which receives the rain is on the roof of the eastern wing of the Observatory, and is about twenty feet above the ground.

ART. XIII.—*On the Genus* TORTULA, *of the Order* MUSCI. By W. J. HOOKER, LL. D. and F.R.S. and F.L.S.; and R. K. GREVILLE, LL. D., F. R. S. E. &c. Communicated by the Authors.

TORTULA.

GEN. CHAR. *Seta* terminalis. *Peristomium* simplex, e dentibus 32 spiraliter tortis, ad basin magis minusve in membranam tubiformem unitis, vel liberis. *Calyptra* dimidiata.

Tortula and *Barbula* of Hedwig, and *Syntrichia* of Bridel.

A genus easily distinguished by the spirally twisted ciliae of its peristome, taken in conjunction with its dimidiate calyptra and terminal fruit-stalk. It was established by Hedwig, who made one of its essential characters to consist in the flowers being monoecious, the male gemmiferous; thus separating from it those individuals which have the flowers diœcious, and the male capituliform, (although agreeing perfectly in habit, and in the other more important characters,) to which he applied the generic name of *Barbula*. So unnatural a division has been almost wholly set aside by modern Muscologists; but still upon the continent the name *Barbula* is generally applied to the species thus incorporated; under the impression, probably, that *Tortula* is pre-occupied among the phenogamous plants. The same appellation has, indeed, been given to a genus of the order *Personatæ* by Dr. Roxburgh, who was ignorant perhaps of its previous application; and this genus has been adopted by Willdenow. But setting aside the right of priority in favour of Hedwig, the *Tortula* of Roxburgh and Willdenow belongs to the genus *Priva* according to some authors, or to *Streptium* according to others; and we can see no adequate reason for discarding the original name from our mosses.

Other writers again, finding in *Tortula subulata* and *ruralis* a membrane, uniting the ciliae for their lower half, have constituted of these individuals the genus *Syntrichia;* but, as is already shown in the Muscologia Britannica, there are some species of *Tortula*, such as *T. cuneifolia*, *tortuosa*, and *unguiculata*, in which a similar membrane exists, but which is so short that they seem completely to unite the two genera *Syntrichia* and *Tortula*.

We cannot boast of a very numerous list of new species to be added to this genus; but we trust that we have rendered as essential a service to the followers of Muscology by endeavouring, as far as we were able, from authentic specimens, to reduce the former list, unquestionably encumbered with some that had no adequate characters to support them. Bridel seems to have been peculiarly unfortunate in his account of the individuals belonging to this genus; and we are much indebted to our friend Mr. Walker Arnott for his assistance in enabling us to refer the Bridelian species to their places of mere varieties, in this our arrangement.

A. *Foliis Enervibus.*

1. Tortula *enervis*, caule brevissimo, foliis paucis lingulatis obtusissimis concavis enervibus rigidis marginibus in-

volutis, operculo conico-acuminato capsulam oblongam sub-breviore.

T. rigida. Sm. Fl. Brit. p. 1249? Engl. Bot. t. 180.

Barbida rigida. Hedw. St. Cr. v. 1. p. 65. t. 25. Mougeat et Nestl. Stirp. Vog. v. 7. n. 613. Schultz. in Nov. Act. Cæs. v. 11. p. 196. t. 32. f. 1.

Bryum stellatum. Schreb. Lips. p. 80?

Hab. Walls and clay-banks, Europe. Near Yarmouth, in England.

The plant of Hudson, who is the original authority for *Tortula rigida*, is, as far as we can judge from his description, and his reference to Dillenius' figure, that to which we retain the name. Its leaves, besides their difference in form from those of the present individual, have a decided nerve. The two mosses in question are very distinct, however authors may have confounded them. We have referred to a few works where the figures or specimens published leave us no doubt upon this point.

2. Tortula *brevirostris*, caule brevissimo, foliis paucis rotundato-ellipticis obtusissimis concavis enervibus rigidis marginibus involutis, operculo conico vix rostellato capsulam oblongam duplo breviore. Tab. XI.

T. rigida. Sw. Musc. Suec. p. 40?

Barbula rigida. Funck. Dutsch. Moos. t. 15.

Hab. Walls and clay banks, Sweden; whence it has been received by Mr. Turner, Sir J. E. Smith, and ourselves. Germany, Funck. Le Vallais, Hooker. On an old wall, near Edinburgh, *D. Steuart, Esq.*

This is the plant alluded to by Turner and Smith, under their descriptions of *T. rigida*, as having a short operculum. We find, besides this character, that its leaves are invariably shorter and broader, and we are therefore inclined to raise it to the rank of a species. The peristome moreover is only half so long as that of *T. enervis.*

B. *Foliis nervosis crassis.*

3. Tortula *rigida*, caule brevissimo, foliis paucis linearibus incurvis sub-mucronulatis canaliculatis nervosis rigidis marginibus involutis, capsula oblonga, operculo rostrato subdimidio breviore.

T. rigida. Turn. Musc. Hib. p. 43? Hook. et Tayl. Musc. Brit. p. 30. t. 12. Hobson Musc. Brit. v. 1.

Trichostomum aloides. Koch in litt. (fide Moug. et Nestl.) Moug. et Nestl. Stirp. v. 8. n. 717.

Bryum rigidum. Huds. Angl. p. 477. Dill. Musc. p. 388. t. 49. f. 55.

Hab. Clay banks, near Yarmouth, and at Henfield, England. In the same situations, France; De Candolle. Sandstone rocks, Pays des Vosges; Moug. et Nestl.

The peristome of this moss is shorter than that of most species of the genus *Tortula,* which has led some botanists to refer it to *Trichostomum;* but the fringe is decidedly twisted both in our specimens and in those of Mougeot and Nestler; and Schultz, not being acquainted with our *T. rigida,* has considered us, in the Musc. Brit. to have fallen into an error in describing the leaves as nerved.

C. *Foliis nervosis tenuibus.*

I. *Foliis perichetialibus convolutis instructis.*

4. Tortula *convoluta,* caule breviusculo, foliis oblongo-lanceolatis acutis marginibus planis, perichætialibus insigniter convolutis, capsula oblonga, operculo rostrato.

T. convoluta, Sw. Musc. Suec.—Sm. Fl. Brit. p. 1253. Engl. Bot. t. 2382. Turn. Musc. Hib. p. 49. Hooker et Tayl. Musc. Brit. p. 34. t. 12. Hobson, Musc. Brit. v. 2. n. 19. Drummond, Musc. Scot. n. 124.

Barbula convoluta, Hedw. St. Cr. v. 1. p. 87. t. 32. Schultz, in Nov. Act. Acad. Cæs. v. 11. p. 214. t. 213. Moug. et Nestl. n. 218. Funck Deutschl. Moos. t. 15. f. 6.

Bryum convolutum, Dicks.

Bryum setaceum, Huds. Dill. Musc. t. 48. f. 44.

Hab. Banks and tops of turf walls, not uncommon in subalpine countries; Europe. In North America; Dr. Torrey.

The perichætial leaves of this moss are strikingly convolute; the hue of the whole plant is yellowish; its setæ pale, like those of *Didymodon pallidum.*

5. Tortula *revoluta,* caule brevi, foliis lanceolatis acutis marginibus insigniter revolutis, perichætialibus vaginantibus involutis, capsula oblonga, operculo rostrato, capsula breviore.

T. revoluta, Brid. Hooker et Tayl. Musc. Brit. p. 33. t. 12. Drummond, Musc. Scot. n. 123.

T. nervosa, Sm. Engl. Bot. t. 2383.

Barbula revoluta, Mohr. Schwaegr. Suppl. p. 127. t. 32. Schultz, in Nov. Act. Acad. Cæs. v. 11. p. 215. t. 33. f. 23. Funck Deutschl. Moos. t. 15. f. 7.

B. convoluta, Moug. et Nestl. Stirp. Crypt. Vog. n. 218.

B. obtusifolia Schwaegr. Suppl. 1. p. 129. t. 31. Schultz, l. c. p. 206. t. 32. f. 13. Funck, l. c. t. 15. f. 8.

B. Hornschuchiana, Schultz, l. c. p. 217. t. 33. f. 25?

Hab. Sandy plains; Europe.

We have no hesitation in quoting *Barbula obtusifolia* of Schwaegrichen as a synonym of this species, its leaves being simply a little broader, and somewhat more obtuse at the extremity. The plant which Schultz has mentioned under the same name appears undoubtedly different, and, as that author himself observes, is more like his *Barbula unguiculata,* its foliage being altogether destitute of the remarkably revolute margins.

B. hornschuchiana of Schultz we can hardly consider distinct from this plant, the margins of the cauline leaves being equally revolute, and those of the perichætium sheathing at the base, but thence lengthened out into a subulate pellucid point.

6. Tortula *calycina*, " caule brevissimo subramoso, foliis lanceolatis undulatis, calycinis elongatis vaginantibus, capsula cylindrica, operculo subulato." *Schwaegr.*

Barbula calycina, Schwaegr. Suppl. ii. p. 63. t. 119.

Hab. New Holland; La Billardiere.

We are unacquainted with this species, and have taken the character entirely from Schwaegrichen.

7. Tortula *flexuosa*, caule elongato ramoso, foliis lanceolato-linearibus carinatis, nervo excurrente, perichætialibus longissimis vaginantibus capsula cylindracea, operculo longe subulato.

T. flexuosa, Hooker, Musc. Exot. t. 125.

Barbula flexuosa, Schultz, in Nov. Act. Acad. Cæs. v. 11. p. 208. t. 33. f. 16.

Hab. Cape of Good Hope; A. Menzies, Esq.

A species remarkable for its very long flexuose fruitstalks, and singularly convolute and attenuated perichætial leaves. The colour of the whole plant is a dingy brown.

8. Tortula *pilifera*, caule elongato valde ramoso, foliis lanceolatis margine revolutis, nervo in pilum longum desinente, perichætialibus vaginantibus, capsula cylindracea, operculo subulato.

T. pilifera, Hooker, Musc. Exot. t. 12.

Barbula crinita, Schultz, in Nov. Act. Acad. Cæs. v. 11. p. 226. t. 34. f. 34.

Hab. Java; whence it was received by Mr. Dickson.

This has the habit of *T. ruralis*; and, like *T. revoluta* and *T. convoluta*, it is furnished with perichætial leaves, differing from the rest in figure. Those of the stem are revolute at the margins, as in *T. revoluta*, but they are moreover terminated by a hair-like extremity.

II. *Foliis uniformibus.*

* *Foliis piliferis.*

9. Tortula *membranifolia*, caule brevi, foliis lato-ovatis membranaceis (albis) in pilum longum acuminatis, nervo superne valde incrassato (viridi) capsula oblonga, operculo rostrato.

T. membranifolia, Hooker, Musc. Exot. t. 26.

Barbula membranifolia, Schultz, in Nov. Act. Acad. Cæs. v. 11. p. 226. t. 34. f. 3.

Tortula chloronotos, Brid. Sp. Musc. v. 1. p. 258.

Barbula chloronotos, Schultz, in Nov. Act. Acad. Cæs. v. 11. p. 222. t. 34. f. 30.

Hab. Teneriffe, Dr. C. Schmidt. Eastern Pyrenées, upon an ochraceous soil; *Bridel. M. Palisot de Beauvois* gave us specimens, marked as native of the environs of Paris, and which are considered by that author as a variety of *T. muralis.*

A most curious and distinct species, which Schultz suspects to be only a diseased state of some moss. It is surprising that he, who has given the figures both of the *chloronotos* of Bridel and of our *membranifolia,* should not be struck with their similarity. The specimens of P. de Beauvois exactly accord with ours.

The remarkable thickening of the nerve is caused by a crowded mass of granules (probably gemmæ) which cover the nerve itself, and spread out on each side of it, leaving a broad, white, transparent, and cellular margin, which, together with the hair-like points of the leaves, give the whole plant a singularly hoary appearance.

10. Tortula *muralis,* caule breviusculo, foliis patentibus anguste oblongis marginibus recurvatis nervo valido pilum incanum longiusculum formante, capsula oblongo-cylindracea, operculo conico-acuminato.

α. Foliis carinatis pilo longo albo.

T. muralis, Hedw. Sp. Musc. p. 123. Swartz, Musc. Suec.—Turn. Musc. Hib. p. 50. Sm. Fl. Brit. p. 1257. Engl. Bot. t. 2033. Hooker et Tayl. Musc. Brit. p. 30. t. 12. Hobs. Musc. Brit. v. 2. Drummond, Musc. Scot. n. 125. Dill. Musc. t. 45. f. 14.

Barbula muralis, Mohr.—Moug. et Nestl. n. 127. Funck Deutschl. Moose, t. 15. f. 11. Schultz, in Nov. Act. Acad. Cæs. v. 11. p. 221. t. 34. f. 29. AB.

B. Vahliana Schultz, l. c. p. 222. t. 34. f. 31.

β. Foliis planiusculis, vix piliferis.

T. muralis, β. æstiva. Bridel, (v. Sm. Fl. Brit.)

Barbula æstiva, Schultz, l. c. p. 223. t. 34. f. 32. Web. et Mohr. Fl. Cr. Germ. p. 207.

B. cuneifolia, Funck Deutschl. Moos. t. 15. f. 12. Schleich. Pl. exsicc.

Hab. Walls and stones, abundant throughout Europe. On trees, South America; *Dr. Gillies.* North America and in the Holy Land; *Bridel.*

We can see no difference whatever between the *Barbula Vahliana* of Schultz and the present species; and with regard to the *B. æstiva,* it has long and justly been considered by Sir J. E. Smith as a mere variety of *T. muralis.* Mr. Arnott regards as synonyms to this plant, *Tortula tenuis* of Sprengel; *T. pilosa* and *hercynica* of Schrader; *T. ambigua* of Röhling; and *B. pilifera* and *hercynica* of Bridel.

We have observed an annulus in this species.

11. Tortula *muralis*, caule elongato, foliis ovato-oblongis carinatis patenti-recurvatis margine recurvo, nervo in pilum longum desinente, capsula cylindrica erecto-curvata, operculo subulato peristomio usque ad medium tubiformis.

α. Vulgaris; *foliis acutiusculis, pilo plerumque hispidulo.*

T. ruralis, Ehrh.—Sw. Musc. Suec.—Turn. Musc. Hib. p. 50. Sm. Fl. Brit. p. 1254. Engl. Bot. t. 2070. Hooker et Tayl. Musc. Brit. p. 31. t. 12. Funck Deutschl. Moos. t. 16. f. 3. Hobs. Musc. Brit. v. 1. Drummond, Musc. Scot. n. 128.

Syntrichia ruralis, Brid.—Mohr.—Br. in Parry's 1st Voyage, App. p. cxcviii. Schultz, in Nov. Act. Acad. Cæs. v. 11. p. 229. t. 34. f. 3.

Syntrichia Norvegica, Web. et Mohr. in Arch. Naturg. t. 5. f. 1.

Barbula ruralis, Hedw. Sp. Musc. p. 121. Moug. et Nestl. Stirp. Vog. n. 26.

Bryum rurale, Linn. Sp. Pl.—Dill. Musc. t. 45. f. 12.

β. Lævipila; *foliis obtusioribus medium versus contractis, pilo plerumque lævi.*

Syntrichia lævipila Brid. Meth. Musc. p. 98. Schultz, in Nov. Act. Acad. Cæs. v. 11. p. 230. t. 34. f. 4.

Tortula lævipila Schwaegr. Suppl. II. p. 66. t. 120.

Hab. Roofs of houses, especially such as are thatched with straw; on walls and on the ground, throughout Europe. Summit of Mont Cenis. Arctic and subarctic America; Capt. Parry and Dr. Richardson. Sandwich Islands and Java; whence we received it by favour of Mr. Dickson. β. Italy and Germany.

This species may be reckoned among the largest of the genus; we have found individuals of it upon Craig Calliach, in Breadalbane, Scotland, which measured seven or eight inches in length. These, however, were barren. The leaves vary somewhat in shape; but we can by no means agree with Bridel and Schwaegrichen, in considering the *T. lævipila* as a distinct species. In the habit there exists no difference, and our specimens of it communicated by Dr. Schwaegrichen are considerably larger than Schultz has described them to be.

Our friend Mr. Lyell, has found a state of this plant without fructification, growing on the trunks of trees at Rumsay, Hants, in which the nerves were gemmiferous, the gemmæ clothing the upper side of the nerve, near the middle of the leaf, of a roundish or oblong form, green, reticulated. The nerve is by no means so dilated as in the gemmiferous plants of *Gymnostomum ovatum.*

* * *Foliis mucronatis.*

† *Peristomio ultra medium tubiformi.*

12. Tortula *mucronifolia*, caule longiusculo subramoso, foliis oblongis acutiusculis mucronatis suberectis carinatis pellucidis margine paululum recurvata capsula cylindracea, operculo conico-rostrato, peristomio medium tubiformi.

α. Europæa; *caule subramosa, capsula recta.*

T. mucronifolia, Hedw. Sp. Musc. Schwaegr. Suppl. I. p. 136. t. 35. Wahl. Lapp. p. 317.

Syntrichia mucronifolia, Brid. Meth. Musc. p. 97. Schultz, in Nov. Act. Acad. Cæs. v. 11. p. 228. t. 34. f. 2. Funck Deutschl. Moos. t. 16. f. 2.

β. Arctica; *caule ramis fastigiatis, capsula erecto-curvata, peristomio fere ad apicem tubiformi albidi.*

Syntrichia mucronifolia, Brown, in Parry's 1st Voyage, Appendix, p. ccxcviii.

Tortula mucronifolia, Hooker, in Parry's 2d Voy. App. ined.

Hab. α. In Switzerland; Schleicher. Austria; Gebhard. β. Discovered in the Arctic regions by the expedition under the command of Capt. Parry.

13. Tortula *subulata*, caule brevissimo, foliis erecto-patentibus oblongo-lanceolatis apiculatis margine plano, capsula cylindrica erecto-curvata, operculo subulato, peristomio ad apicem fere tubiformi.

α. *Foliis acuminatis.*

T. subulata, Hedw. Sp. Musc. p. 122. t. 27. Schwaegr. Suppl. I. p. 135. t. 34. Sm. Engl. Bot. t. 1101. Hooker et Tayl. Musc. Brit. p. 31. t. 12.

Barbula subulata, Brid.—Moug. et Nestl. Stirp. Vog. n. 126.

Syntrichia subulata, Web. et Mohr, Tasch. p. 214. Schultz, in Nov. Act. Acad. Cæs. v. 11. p. 227. t. 34. f. 1. A. B. *

β. *Foliis oblongis obtusis (cum mucrone.)*

Hab. On the ground, in all parts of Europe. β. New Forest, Hampshire; C. Lyell, Esq.

14. Tortula *leucostoma*, "caule subsimplici, foliis ovato-lanceolatis mucronulatis integerrimis, capsula cylindracea erecta, operculo conico, peristomii dentibus obliquis apice tortis."

Barbula leucostoma, Brown, in Parry's 1st Voy. App. p. ccxcviii.

With this species, which Mr. Brown regards as intermediate between *Barbula* and *Didymodon*, we are entirely unacquainted. According to that author, it is about half an inch in height, the leaves with a revolute margin, and slightly twisted when dry. Peristome white, of 32 teeth, approximated in pairs, and united for about their lower half into a tube.

†† *Peristomii dentibus fere omnino liberis.*

15. Tortula *unguiculata*, caule elongato ramoso, foliis ob-

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* We have Mr. Arnott's authority for adding *Syntrichia alpina* of Bridel; and that of Schultz for quoting *Barbula macrocarpa*, as synonyms to this species.

longo-lanceolatis subcarinatis obtusis apiculatis, margine subrecurvo, capsula oblongo-ovata, operculo longe rostrato.

T. unguiculata, Hedw. St. Cr. v. 1. t. 23. (ic. bona,) Moug. et Nestl. Stirp. Vog. n. 27. Funck Deutsch. Moos. t. 15. f. 2.

Barbula acuminata, Hedw. Sp. Musc. p. 117. t. 25. f. 5—7. Schultz, in Nov. Act. Acad. Cæs. v. 11. p. 202. t. 32. f. 9.

Tortula mucronulata, Swartz, Musc. Suec. p. 40. Turn. Musc. Hib. p. 47. Sm. Fl. Brit. p. 1250. Engl. Bot. t. 1299.

T. aristata, Sm. Fl. Brit. p. 1261. Engl. Bot. t. 2393.

T. barbata, Sm. Fl. Brit. p. 1260. Engl. Bot. t. 2391.

T. humilis, Turn. Musc. Hib. p. 45. Sm. Engl. Bot. t. 1663. (not Barbula humilis of Hedw. and Schwaegr.)

T. apiculata Hedw. Sp. Musc. p. 117. t. 26. f. 1—4. Turn. Musc. Hib. p. 46. Sm. Engl. Bot. t. 2494. Schultz, in Nov. Act. Acad. Cæs. v. 11. p. 202. t. 33. f. 17.

T. ericetorum, Sm. Fl. Brit. p. 1258. Engl. Bot. t. 2495.

Barbula cuspidata, Schultz, l. c. p. 206. t. 32. f. 14. A. and B. elongata.

B. fastigiata, Schultz, l. c. p. 207. t. 33. f. 15.

B. microcarpa, Schultz, l. c. p. 209. t. 33. f. 18.

B. agraria, Schleicher Cat.

B. lanceolata, Hedw. Sp. Musc. p. 119. t. 26. Schultz, l. c. p. 203. t. 32. f. 10.

B. stricta, Hedw. Sp. Musc. p. 119. t. 26. Schultz, l. c. p. 203. t. 32. f. 11. Dill. Musc. t. 48. f. 48–49.

Hab. Banks and hedges throughout Europe.

Equally variable as, or perhaps even more so, than *T. fallax*. We do not see how the *B. cuspidata* of Schultz differs from this. The *B. fastigiata* of the same writer, is by himself pronounced to be very possibly but a large variety of *B. cuspidata*. His *B. microcarpa* he considers as it were intermediate between *B. apiculata* (Hedw.) and *B. unguiculata*. Mr. Arnott, upon the authority of authentic specimens, affirms that the *B. dubia* of Bridel, *B. gracilis*, and *B. amoena* of Schumacher, *Fl. Saell.* are the same as *B. unguiculata*. *

We have the *T. apiculata* from Mühlenberg, and a plant from America sent by Sprengel, under the name of *T. acuminata*, which agreeing with the *acuminata* of Hedwig, we are inclined to think that both of them are the same with *T. unguiculata*.

16. Tortula *Funckiana*, "caule gracili subramoso, foliis ovato-lanceolatis concavis margine planis erecto-patulis, theca oblonga arcuata, operculo subulato." *Schultz.*

Barbula Funckiana, Schultz, in Nov. Act. Acad. Cæs. v. 11. p. 218. t. 33. f. 26.

Hab. On the Alps of Salzburg; Funck.

We have not seen specimens of this moss; but there seems reason to suspect, from the figure and description given by Schultz, that it is too nearly allied to *T. unguiculata.*

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* We have also quoted, on Mr. Arnott's authority, *Barbula lanceolata* and *B. stricta* of Hedwig, whose figures sufficiently accord with our species.

17. Tortula *cæspitosa,* "caule brevissimo subramoso, foliis lineari-oblongis mucronatis erectiusculis, theca cylindrica, operculo mediocri." Schwaegr.

Barbula cæspitosa, Schwaegr. Suppl. II. p. 121. t. 31. Schultz, in Nov. Act. Acad. Cæs. v. 11. p. 201. t. 32. f. 7.

Hab. Pennsylvania; Mühlenberg.

We do not possess authentic specimens of this plant; but in Mr. Dickson's Herbarium, we have seen individuals which agree entirely with the figure and description given by Schwaegrichen, and from which we conclude it to be a distinct species. The leaves are longer than those of *T. stellata,* and in shape they are more similar to those of *T. pellucida,* but they are plane, decidedly mucronate, and less pellucid than those of the latter species.

18. Tortula *pellucida,* caule brevi, foliis lineari-lanceolatis concavis erecto-patentibus reticulato-pellucidis basi albis, apice obtusiusculis mucronulatis nervo crasso, capsula cylindracea operculo longe rostrato. Tab. XII.

Bryum acuminatum, Sw. Prodr. p. 139. (not Barbula acuminata, Hedw.)

Barbula agraria, β. acuminata, Brid. et Schultz.

Hab. Jamaica, (received from Dr. Swartz; and from Dr. Schwaegrichen, under the name of *Barbula acuminata.*)

The texture of the leaves is very thin and delicate, much like that of *T. cuneifolia.* Swartz, in his *Flora Indica Occidentalis,* p. 1764, (note,) has considered this to be a variety of *Tortula agraria;* but it is unquestionably a very distinct species, and that excellent author has noticed the principal difference. Following Swartz, Bridel makes it a variety of his *Barbula agraria;* but he has erred in saying that its leaves have the margins *re*flexed. Swartz's term is *in*flexed. Schultz likewise adopts the same arrangement.

19. Tortula *stellata,* caule brevissimo cæspitoso, foliis oblongo-ovatis ovatisve rigidiusculis concaviusculis subopacis, acutis mucronulatis, nervo valido fuscescente percursis.

T. stellata, Sm. Fl. Brit. p. 1254. Engl. Bot. t. 2384. Hooker and Tayl. Musc. Brit. p. 32. t. 12.

Bryum stellatum, Dicks. Crypt. Fasc. 2. excluding the synonym.

Barbula agraria, Hedw. St. Cr. v. 3. t. 6. Schwaegr. Suppl. v. 1. p. 129. Schultz, in Nov. Act. Acad. Cæs. v. 11. p. 199. t. 32. f. 4.

B. domestica, Reichard MSS. Brid.—Schultz, l. c. p. 200. t. 32. f. 5.

Hab. Scotland, according to Mr. Dickson, from whom we have received specimens of it. Jamaica, Swartz. Domingo and Guadaloupe, Schwaegr. and Schultz. St. Vincents and Island of Grenada, Rev. L. Guilding.

Allied to *T. humilis*, but with shorter, more rigid and less opaque leaves. Mr. Dickson's name has the priority, and the plant to which he applied the appellation, is undoubtedly the same as *B. agraria* of Hedwig. We have received *B. domestica* from Reichard himself, and find it to be in no respect different from *T. stellata*.

20. Tortula *cuneifolia*, caule subnullo, foliis latissime obovatis concaviusculis pellucidis, nervo in mucronem longiusculam excurrente, capsula oblonga, operculo brevirostrato (peristomii ciliis basi unitis.)

T. cuneifolia, Roth. Fl. Germ.—Turn. Musc. Hib. p. 51. Sm. Fl. Brit. p. 1257. Engl. Bot. t. 1510. Hooker et Tayl. Musc. Brit. p. 32. t. 12. et 2. compartment 1. f. 2.

Bryum cuneifolium, Dicks. St. Crypt. fasc. 3.

Barbula Dicksoniana, Schultz, in Nov. Act. Acad. Cæs. v. 11. p. 224. t. 34. f. 33. Dill. Musc. t. 45. f. 15.

Hab. Banks and fields in the south and east of England. Canary Isles; Dr. C. Schmidt. Pyrenees; Professor De Candolle.

Foreign authors seem to have no knowledge of this plant, which is one of the most distinct species in the genus. Bridel appears, by his reference to Dillenius, to have called it *Barbula mutica*.

21. Tortula *indica*, caule breviusculo subramoso, foliis lineari-oblongis erectis subapiculatis siccitate crispatis, capsula oblonga, operculo acuminato.

T. indica, Hooker, Musc. Exot. t. 135.

Trichostomum indicum, Willd. in Bot. Mag. v. 4. p. 7. t. 1. (fide Schwaegr.) Schwaegr. Suppl. I. p. 242. t. 36.

Hab. In the East Indies; Röttler. On the walls of the Botanic garden at Calcutta in the East Indies; Dr. Wallich.

Our reasons for referring this moss to the genus *Tortula*, are stated in the work quoted above. Other authors appear to be ignorant of the nature of its perfect peristome.

22. Tortula *recurvata*, caule subnullo, foliis erecto-patentibus lanceolatis acutis marginibus superne recurvis, nervo crasso in mucronem brevem excurrente, seta elongata, capsula cylindracea, operculo breviusculo conico-cylindraceo.

T. recurvata, Hooker, Musc. Exot. t. 130.

Barbula recurvata, Schultz, in Nov. Act. Acad. Cæs. v. 11. p. 216. t. 33. f. 24.

Hab. Cape of Good Hope, in Rogeveld, between Jackals Fonteyn, and Kuylenberg, on the ground; W. J. Burchell, Esq.

23. Tortula *flavescens*, caule elongato ramoso, foliis erectis siccitate tortilibus e basi ovatis apice acuminatis apiculatis inferne margine recurvo, capsula cylindracea, operculo subulato capsulam æquante. Tab. XII.

Hab. On a clayey soil. Nepaul; Dr. Wallich.

Somewhat resembling *T. fallax* in habit; but with the leaves much more acuminated, erect when moist, and crisped when dry. If seen under the high power of a microscope, the margins of the leaves, and back of the nerve, appear minutely jagged or denticulate. The whole is of a yellowish tint.

(Foliis exacte linearibus subapiculatis.)

24. Tortula *angustifolia*, caule elongato subramoso, foliis linearibus carinatis acutis subapiculatis rigidiusculis siccitate tortilibus, capsula cylindracea, operculo longi-rostrato. Tab. XII.

Hab. Nepaul; Dr. Wallich.

Allied on the one hand to *T. linearis*, on the other to T. *tortuosa*; differing from the former in its elongated stems, and carinated, scarcely mucronated, leaves; from the latter in its much smaller size, and never undulated leaves.

25. Tortula *linearis*, caule subnullo, foliis linearibus acutis planiusculis submucronulatis nervo crasso, capsula anguste cylindrica, operculo subulato capsula dimidio breviore.

T. linearis, Sw. Fl. Ind. Occ. v. 3. p. 1765.

Barbula linearis, Schwaegr. Suppl. v. 1. p. 119. t. 30. Schultz, in Nov. Act. Acad. Cæs. v. 11. p. 200. t. 32. f. 6.

Hab. Dry calcareous places in the West Indies; Swartz. Rio Janeiro, according to Mr. Arnott.

Well distinguished by its exceedingly short stems, and its narrow, long, and exactly linear leaves, which are scarcely crisped when dry.

* * * *Foliis muticis.*

† *Foliis siccitate tortilibus.*

26. Tortula *tortuosa*, caule elongato ramoso, foliis patentibus lineari-subulatis carinatis undulatis siccitate crispatis, capsula cylindracea, operculo longirostrato.

T. tortuosa, Hedw. Sp. Musc. p. 124. Turn. Musc. Hib. p. 52. Sm. Fl. Brit. p. 1258. Engl. Bot. t. 1708. Hooker et Tayl. Musc. Brit. p. 32. t. 12. Hobs. Musc. Brit. v. 2. n. 17. Drummond, Musc. Scot. n. 19.

Barbula tortuosa, Schwaegr. Suppl. p. 129. t. 33. Moug. et Nestl. Stirp. Vog. n. 314. Funck Deutsch. Moos. t. 15. n. 9. Schultz, in Nov. Act. Acad. Cæs. v. 11. p. 219. t. 34. f. 28.

Bryum tortuosum, Linn.—Dill. Musc. t. 48. f. 40.

Hab. Rocks, especially on a calcareous soil; Europe and America.

Stems long, and clothed with leaves, which are the longest, and, when dry, the most twisted of those of any species in the genus; their margins, too, are singularly undulated.

27. Tortula *inclinata*, caule breviusculo ramoso, foliis

erectiusculis linearibus (basi latioribus) carinatis subundulatis siccitate crispatis, capsula oblongo-cylindracea subcurvata, operculo longirostrato.

T. inclinata Hedw. fil. apud *Web.* et Mohr. Beitr. v. 1. p. 123. t. 5.

Barbula inclinata Schwaegr. Suppl. p. 131. t. 33. Funck Deutsch. Moos. t. 15. f. 10. Schultz in Nov. Act. Acad. Cæs. v. 11. p. 218. t. 33. f. 27.

β *Capsula longiore graciliore.*

Hab. Alps of Germany and Switzerland. β. Cape of Good Hope *A. Menzies, Esq.*

Undoubtedly very close allied to *T. tortuosa,* but differing in its much shorter, and, when moist, more erect leaves, and the more curved capsule.

The var. β. found by Mr. Menzies at the Cape of Good Hope, only seems to vary in having a longer and slenderer capsule.

†† *Foliis subcrispatis vel strictis.*

28. Tortula *robusta,* caule elongato-ramoso, foliis patento-recurvatis flaccidis late lanceolatis sublonge acuminatis carinatis, margine plano paululum undulato, capsula cylindracea. Tab. XII.

Hab. Received from Mr. Dickson, but without any station being named.

This is the stoutest in its mode of growth of all the species; it is about two inches long, branched, clothed with long, subsquarrose, recurved and singularly sharply acuminated leaves, of a brown colour. The operculum and entire peristome have not been seen by us; but the plant has much the habit of T. *ruralis.*

29. Tortula *serrulata,* caule elongato subramoso, foliis lanceolatis carinatis acuminatis apice serrulatis margine plano, nervo valido, capsula cylindracea inclinata. Tab. XII.

Hab. Terra del Fuego. Received from *Mr. Dickson.*

The only species which we know, possessing leaves with a decided serrature. Their colour is a fine orange-brown, when seen under the microscope; the seta and capsule brown; the peristome much twisted, and united at the base into a tubiform membrane.

30. Tortula *fallax,* caule elongato ramoso, foliis lanceolatis acuminatis carinatis patentibus vel recurvis marginibus reflexis, capsula oblonga, operculo longe rostrato.

α. *caule subunciali, foliis siccitate recurvis.*

T. fallax. Swartz Musc. Suec. p. 40. Turn. Musc. Hib. p. 48. Sm. Engl. Bot. t. 1708. Hooker et Tayl. Musc. Brit. p. 32. t. 12. Hobs. Musc. Brit. v. 2. n. 18. Drummond, Musc. Scot. n. 20.

Barbula fallax. Hedw. St. Cr. v. 1. t. 24. Moug. et Nestl. Stirp. Vog. v. 7. n. 715. Funck Deutsch. Moos. t. 15. f. 5. Schultz in Nov. Act. Acad. Cæs. v. 11. p. 211. t. 33. f. 21. A.

T. imberbis. Sm. Fl. Brit. p. 1261. Engl. Bot. t. 2329.

T. unguiculata Turn. Musc. Hib. p. 47. Sm. Fl. Brit. p. 1251. Engl. Bot. t. 2316. (not of Hedw.) Dill. Musc. t. 48. f. 46—47.

β. Caule bi-triunciali, foliis patentibus longioribus.

Barbula linoides Brid. Meth. Musc. p. 90. (not Tortula linoides Engl. Bot.) Bryum linoides Dicks. Crypt. Fasc. 3. p. 8. t. 8. f. 3.

γ. Caule semipollicari, seta elongata.

Barbula brevicaulis Schwaegr. Suppl. v. 1. p. 126. t. 32.

Hab. Clay-banks and fields, common; Europe. β. In very wet situations. Ireland, Dr. Taylor. Yorkshire, Mr. Backhouse. γ. Switzerland, Schleicher. Dutchy of Mecklenberg, Schultz.

An exceedingly variable plant, of which many species have been made. Mr. Arnott, who, with great patience has investigated the mosses of Bridel, enumerates the following as varieties of *T. fallax. Barbula flavescens, reflexa, Atlantica, Turneri* and *Saussuriana.* Schultz farther refers to the same species, *Tortula Atlantica* and *reflexa,* and *Barbula orientalis* of Bridel; and *Barbula nervosa* of Blandow.

We scarcely know to what the varieties β. and γ. of Schultz properly belong; like our var. β. of *T. gracilis,* they appear to be intermediate between *T. gracilis* and *T. fallax,* and we are much inclined to think that all might with propriety come under the latter and older species.

Upon the authority of original specimens, Schultz considers *Barbula orientalis* of Bridel as a variety of *T. fallax,* having the leaves more slender, straight, and erecto-patent.

31. Tortula *gracilis,* caule elongato subramoso, foliis lanceolato-acuminatis erectis rigidis siccitate strictissimis margine recurvato, capsula oblongo-ovata, operculo rostrato breviusculo.

Barbula gracilis Schwaegr. Suppl. p. 125. t. 34. Schultz in Nov. Act. Acad. Cæs. v. 11. p. 198. t. 32. f. 3.

β. Viridis, caulibus foliisque sublatioribus paululum patentibus.

T. brevifolia Sm. Fl. Brit. p. 1259. Eng. Bot. t. 2453.

Hab. Sandy soil, near Bex, Switzerland, Schleicher. Near Deux Ponts, Bruch. β. Near Cork, Mr. Drummond. Yorkshire, Dr. Richardson. Durham and Northumberland, Mr. Winch. Scotland, Mr. Dickson and Mr. Drummond.

Very closely allied to *T. fallux,* but a smaller, slenderer plant; its leaves far more rigid, more erect and very strait, when dry quite appressed to the stem. Colour brownish in α; green in β. which latter appearance is so like *T. fallax,* that we have hesitated to which of the two species to refer it. Mr. Arnott, indeed, pronounces that *T. gracilis* is not distinct from *T. fallax;* and, moreover, observes that it is not uncommon in Scotland.

32. Tortula *paludosa*, caule elongato ramis dense cæspitoso, foliis subpatentibus lanceolatis acutis planiusculis marginibus planis, capsula cylindracea, operculo longe subulato.

Barbula Paludosa, Schwaegr. Suppl. I. p. 124. t. 50. Schultz in Nov. Act. Acad. Cæs. v. 11. p. 210. t. 33. f. 19. Funck Deutsch. Moos. t. 15. f. 4.

B. crocea. Web. et Mohr Crypt. Germ. p. 481.

Hab. Wet places on the ground, in Switzerland, Carniola, and Germany.

This appears to be a very well defined species, not yet found in Britain; approaching however nearest to *fallax* of any hitherto described *Tortula*. Its leaves however are of a softer texture, their margins never patent, and it has a much denser mode of growth. Colour rather deep yellow green.

33. Tortula *Australasiæ*, caule breviusculo vix ramoso, foliis lineari-lanceolatis carinatis acutissimis patentibus siccitate tortilibus, capsula ovato-cylindracea, operculo brevirostrato. Tab. XII.

Hab. King George's Sound, New Holland. A. Menzies Esq. 1791.

Stems nearly half an inch high, with the leaves distantly placed at the base, but more crowded above. Habit not unlike that of *Didymodon purpureum*, but assuredly belonging to the genus *Tortula*, with the ciliae united at the base into a membrane, Colour reddish.

34. Tortula *humilis*, caule perbrevi, foliis lineari-oblongis obtusiusculis opacis undulatis basi pellucidis, capsula oblonga, operculo longe rostrato.

Barbula humilis, Hedw. Sp. Musc. p. 116. t. 25. f. 1. 4. Dill. Musc. p. 389. t. 49. f. 56.

Hab. Pennsylvania, whence our specimens were sent to Dr. Swartz, by Muhlenberg.—In the highlands of New York, and upon rotten logs in Cedar Swamps: Dr. Torrey.

Certainly distinct from *T. unguiculata*, and from what has been called *T. humilis* in Europe. The peculiarities of the present species consist in its longer, not apiculated, leaves, which are of a flaccid texture, and dull green colour, waved, pellucid at the base, and furnished with a strong yellowish nerve.

35. Tortula? *Sprengelii*, "caule simplici geniculato, foliis lingulatis acutis subtortilibus, capsula teretiuscula, operculo longerostri." *Schwaegr.*

Barbula Sprengelii, Schwaegr. Suppl. II. p. 64. t. 119.

Hab. Hispaniola (Sprengel).

This plant, of which we have never seen specimens, is figured by Schwaegrichen with a peristome unlike that of any known *Tortula*, and Mr. Arnott informs us that it is an undoubted *Weissia*.

36. Tortula *curta*, "caule brevi simplici, foliis lanceolato-subulatis rigidis caule adpressis, theca brevi cylindrica, operculo conico subulato recto." *Schultz.*

T. curta, Sw. Musc. Suec. p. 41.

Barbula curta. Hedw. St. Cr. v. 3. p. 75. t. 31. Schultz, in Nov. Act. Acad. Cæs. v. 11. p. 199. t. 32. f. 2.

Desmatodon curtus Brid. Meth.

Hab. Sandy plains, Sweden.

We have never had the opportunity of examining authentic specimens of this moss. The peristome, as figured by Hedwig, bears little or no similarity to that of *Tortula*. Bridel constitutes of this plant, together with *Dicranum latifolium*, the genus *Desmatodon*. Mr. Arnott says that *Barbula curta* is certainly a *Didymodon*, ranking between *D. tenue* and *D. tortile;* and that more than one species of that genus have the teeth slightly united at the base.

37. Tortula *parvula*, caule brevissimo, foliis paucis patentibus anguste ovatis concavis acutiusculis marginibus apice incurvis, seta brevi, capsula oblongo-ovata, operculo brevirostrato. Tab. XII.

Hab. Cape of Good Hope, A. Menzies, Esq. 1791.

We know of no species that comes near this:—at first sight it has the general aspect of *T. rigida* or *enervis*, and is of the same lurid colour; but its leaves are by no means of that thick and rigid texture, and it is at the upper part alone that the inflexion of their margins takes place.

It is the smallest species of *Tortula* which we know of, the whole plant, including the seta, being scarcely more than half an inch in height.

Art. XIV.—CONTRIBUTIONS TO POPULAR SCIENCE.

No. II. On a Method of Reading the Incriptions on Coins and Medals in the Dark, with Remarks on the Radiation of Metallic Surfaces.

Among the numerous experiments of a striking and popular nature, with which science astonishes, and sometimes even strikes terror into the ignorant, there is perhaps none more calculated to produce this effect than the one which forms the subject of the present article, while it possesses at the same time the higher advantage of presenting to us some scientific facts, which we believe have not hitherto been observed.

It has long been known that *black* surfaces radiate heat, or throw it off more copiously than *white* surfaces; and that the same difference takes place between *rough* and *polished* surfaces; those which are rough producing the same effect as those which are black; but in so far as we learn, no experiment has been made to prove, that the same results take place with *radiant light;* that is, that when bodies are heated to such a degree as to *radiate light*, those which have *black* or *rough* surfaces *discharge the light* more copiously than those which are *white* or *polished.*

This result respecting radiant light might no doubt have been inferred from the experiments on the radiation of heat, if these two substances had been previously found to comport themselves in a similar manner when thrown off by bodies, or reflected from their surfaces. But this has never been established; and therefore such an inference would have been premature in the present state of our knowledge. If we confide in experiments already made, indeed, we should be disposed to conclude, that light and heat do not follow the same laws, at least in their reflexion from bodies. Brass, for example, is said by Mr. Leslie to have a reflective power for *heat* of 100°, while silver has only a reflective power of 90°; but we know for certain, that silver reflects light much more copiously than brass. Notwithstanding this apparent discrepancy, we would rather question the accuracy of the experiment, than the truth of a law which has been long considered as general.

During the experiments on the revival of the inscription on coins by unequal oxidation, which we have described in our last Number, we had occasion to expose to a high degree of heat a coin, on which the inscription had been rendered black by oxidation. Upon taking the coin, while in a state of bright red heat, into a dark room, we were surprised to observe that the letters of the inscription were more luminous than the rest of the coin, in consequence of their oxidated surface radiating the red light more copiously than the other parts. Though the effect was not in this case sufficiently striking to enable me to read the inscription, yet it occurred to me, that if by the action of an acid, or any mechanical means, the general surface of the coin should be made rough, or have its polish removed, while the raised points which constituted the inscription and the figure were polished, an effect opposite to that in the preceding experiment should be produced. I accordingly took a French shilling of Louis XV. and having roughened the depressed parts of the surface, and heightened the polish of the inscription, &c. I placed it upon a red hot mass of iron, and removed it into a dark room. When the shilling began to radiate light, the inscription, BENEDICTUM SIT NOMEN DEI, appeared in obscure letters, while the ground on which they stood shone with a brilliant light. By polishing the depressed parts of the surface, and roughening the letters, I obtained, as might have been expected, the opposite effect, the inscription being now legible, from its throwing off more light than the surrounding surface.

In order to perform this experiment with most success, it is desirable to conceal from the observer's eye the mass of red hot iron on which the coin is placed, both for the purpose of rendering the eye fitter for observing the effect, and of removing all doubt that the inscription is really read in the dark; that is, without the light of any other body either direct or reflected falling upon it.

The most striking form in which this experiment can be exhibited, is to use a coin from which the inscription has either been wholly obliterated, or obliterated in such a degree as to be no longer legible. When such a coin is laid upon the red hot iron, the letters and figure become oxidated, as formerly described; and the black or brown film of oxide which is found upon them radiating more powerfully than the rest of the coin, the letters will shine more brilliantly than the other parts, and may be read to the great surprise of the observer, who had examined the blank surface of the coin before it had been placed upon the iron. His surprise will not be diminished, when he observes that the letters which he saw more luminous than the rest are now covered with a black film of oxide.

As the different radiating powers of parts of the same surface, can neither be seen by the eye nor indicated by any instrument, when the general temperature is below that of red heat, the principle of the preceding experiment may be employed to determine the relative powers of radiation possessed by different metals. Although the radiating powers, for example, of *gold*, *silver*, *copper*, and *tin plate*, are, according to the experiments of Mr. Leslie, *exactly* the same, yet we are persuaded that the preceding method will afford ocular demonstration of the incorrectness of this result, when these bodies are submitted to the experiment under the same circumstances of magnitude, thickness, and polish, in so far as this can be done. This opinion is not hazarded on an idle conjecture, but is founded on very unequivocal experiments on the reflective powers of these metals for light, which differ in a very considerable degree, and which in general have a fixed relation to their radiating powers.

In the case of pure silver, which has been ground and polished, the reflective power exceeds that of all other metals that we have tried; and we cannot suppose it a matter of doubt, that the radiating power of silver is much less than that of gold or copper, and inferior to that of tin plate.

Among the other laws of radiation, it has been announced that the thinnest coat of a metallic body produces as great an effect as the thickest. This law is by no means improbable, but it requires to be confirmed by nicer methods than those by which it was obtained; and we are not aware that a more correct one can be found than the process which has been mentioned.

In the experiment with the coin, where the different parts radiate different degrees of light, the effect does not show itself till the heat has risen to a particular degree of intensity. As this point may vary with different metals, and with the different states or conditions of the two radiating surfaces, might it not be employed with success for pyrometrical purposes, when the temperature to be measured exceeds that of red heat? A series of well-devised and nicely conducted experiments on this subject, would lead to very interesting results, even if they should not afford data for the construction of a new pyrometer.

There are many other useful purposes in the arts, as well as in the sciences, to which we conceive the preceding results may be applicable; but as the discussion of them would not be appropriate in a popular article like the present, we shall resume the subject on some future occasion.

(B.)

ART. XV.—*Remarks suggested by the Resemblance which certain ancient Stone Axes found in Orkney and Shetland bear to those which have been found near the Humber.* By SAMUEL HIBBERT, M. D. F. R. S. E. and Secretary to the Society of Scottish Antiquaries, &c. Communicated by the Author.

THE weapons which form the subject of the present short memoir have long been improperly described under the name of *Celts.* The origin of this appellation, so gratuitously assigned to them by antiquaries, is easily explained. All nations that spoke such dialects as the English, the Scotch, the German, or the Norwegian, as well as those tribes of people whose language was Welsh, Gaelic, or Armorican, were alike supposed to be the same ancient races of Europe, to whom Roman historians have given the name of *Celtæ.* No wonder, then, that to all implements of war, indicative of the earliest state of manners in Europe, the same common name of *Celts* should, with little discrimination, have been applied; but the reason why the appellation still continues to be retained by antiquaries is not so obvious. Dr. Percy, in the valuable historical essay prefixed to his translation of Mallet's Northern Antiquities, was the first to successfully point out the impropriety of assigning to Scandinavian, Saxon, Anglo-Saxon, German, or any other northern nations speaking dialects of one common language so widely differing from the Welsh or Gaelic tongue, any other name than that of *Teutonic.* But, notwithstanding this important distinction, the correctness of which every one has admitted, antiquaries, with a strange inconsistency, have not only continued to give to every rude warlike implement which may be found the name of Celt, heedless whether it might be really Teutonic or not, but have even forced the false appellations which they have adopted into their speculations. Thus, the learned author of Caledonia, proceeding upon the incorrect notion, that stone axes are the unequivocal relics which Celtic tribes left behind them when they evacuated the Orkney Islands, argues that a Celtic race never dwelt in Shetland, because stone axes are not there to be found; nay, he even forces the *assumed* Celtic origin of these relics into the longcontested Pictish question. We shall now, however, consider what may be the real state of the argument.

First, then, it must be admitted, from historical evidence, that there is no proof that any Celtic tribes ever inhabited Shetland. All northern annals prove that this country, in its earliest known state, was the haunt or refuge of the Vikingr or Sea-kings, and that, sailing from such obscure lurking-places, they made various piratical descents upon the shores of Britain, France, and other fertile districts of Europe.

Secondly, in contradiction to the supposition of Mr. Chalmers, who must have been strangely misinformed on the subject, stone axes are very abundantly found in Shetland. Hence, these weapons must be Teutonic, and they must have been used either by Saxon or Scandinavian rovers, or perhaps by both of these tribes, there being originally little distinction between them. The real question, then, to be decided is, were such ancient stone axes as are found in the British islands ever used by Celtic as well as Teutonic tribes? On this point I think it may be shown, that military weapons of copper (to which likewise the name of *Celts* is applied) are most abundantly found in proper Celtic provinces. But the subject is well worth a farther investigation.

Yet if any doubt can still exist that stone axes were really either Scandinavian or Saxon implements of war, it is removed by an extract from an ancient Teutonic romance of the eighth century, to be found in Eccard's Commentaries "de Rebus Franciae Orientalis." This has been reprinted in an interesting work on Northern Antiquities, edited by Mr. Jamieson and Mr. Weber. The passage to which I allude is thus translated: "Then they first let ashen spears fly with rapid force, that they stuck in the shields. Then they thrust together resounding stone axes." The expression *stone axes* is in the original *Staimbort*,—a term compounded of such words of later orthography as *stein*, a stone, and *barte*, an axe. Hence I have had no hesitation in giving to stone axes the only name by which we find them to be recorded, namely *Steinbartes* or *Staimborts*.

There are, however, different forms of steinbartes. One found in England, and described by Whittaker, in his History of Manchester, materially differs from those which form the subject of the present paper. The blade of Whittaker's stone axe contains an orifice calculated to admit within it a wooden haft, but there is no orifice displayed by the blade of the Shetland Steinbarte; on the contrary, it is itself passed through the aperture of a handle, for which its tapering extremity is adapted. The next question then is, did each different early tribe of Europe use some peculiar shape of a stone-axe, so as, in fact, to form a mark of distinction among Teutonic warriors? I am inclined to believe that this was the case, for the following reason: That in Orkney and Shetland, the stone-axes peculiar to these provinces have an uniform character. As these, therefore, were islands frequented by Scandinavian and Saxon pirates, I have considered that, in whatever country of Europe weapons similar to them might be found, a visitation from the Vikingr, or Sea-kings of the north, is strongly indicated.

Entertaining this view, it has often struck me, that steinbartes possessing this particular shape ought to be found in England, to the fertile coasts of which country the barks of the Northmen were not unfrequently steered. Thus Torfæus remarks of Eric, who lived about the eighth or ninth century, "Hic auctus Hiberniam et inde Bretlendiam seu Cornaviam diripuit, mox successu audacior austrum versus trajiciens, Angliam depopulatus est." I could quote numerous other instances of similar descents on the English shores. The last summer, however, I was agreeably surprised, while making a geological excursion to that part of Lincolnshire which lies near the confluence of the Trent and the Ouse, to learn that stone-axes of precisely the same shape which I had been accustomed to see in Shetland, had been found in several places in that vicinity. This spot, in fact, would, of all others, present a desirable landing place for pirates, as it commands two distinct tracts of country, divided from each other by an unfordable river, but each of which would be assailable by means of sailing vessels. The Humber was likewise the boundary of the kingdoms of Myrcia and Northumberland, which certainly owed their origin to northern rovers.

But I dare not continue my speculations any farther on the circumstance of steinbartes being found at Orkney and

Shetland as well as near the Humber; being too well aware of the danger of falling into that sort of antiquarian reasoning which has been employed by much graver men than honest Fluellin,—that "there is a river at Macedon, and a river at Monmouth, and that there are salmons in both."

I must, however, remark, that a classification of the various stone axes found in Britain, with a statement of the distinct forms, the particular places in which they have been discovered, and the relics of antiquity found near them, would throw no inconsiderable light on the early annals of our country.

⁂ The Orkney and Shetland steinbarte alluded to in the foregoing memoir is represented in Plate IX. Fig. 3. Stone blades of this kind are found from four to ten inches in length; their breadth proportionally differing. When the blade of the steinbarte was used, its blunt tapering extremity may be supposed to have been introduced within the perforation made into some wooden or bone haft, and afterwards secured by overlapping cords, formed of thongs of leather, or of the entrails of some animal; twine of hemp not being then in use. This complete state of the Orkney and Shetland steinbarte I have accordingly endeavoured to represent in the engraving.

It has been remarked, that some stone axes of the same form have been, at different times, found near the Humber. One of these was presented to me when I visited Burton Strather, in Lincolnshire, in the course of the last summer. I have also seen a steinbarte of this kind found in another district of England, viz. in Warwickshire.

ART. XVI.—*Description of an improved Hair Hygrometer.*

By M. BABINET.

As the hair hygrometer of M. de Saussure has been almost invariably used by the continental philosophers as the most accurate instrument for measuring the moisture of the air, any real improvement upon it will be regarded by the experimental philosopher as a valuable acquisition to science. The hygrometer of M. Babinet seems to possess this character in no inconsiderable degree, and as a very favourable report upon it has been made to the Academy of Sciences by a very competent judge, M. Fresnel, we shall submit to our readers a drawing and description of it, abridged from the *Journal de Pharmacie* for April, 1824.

This instrument is represented in Plate IX. Fig. 4, where 1, 1, 1, 1, is a copper cylinder, resting upon a pedestal, and having large apertures cut out of it. When the interior of the instrument is to be shut up from the external air, its upper part is surrounded with a cylinder of glass, 2, 2, 2, 2, fixed at its two ends (with green wax) to the upper rings which project round the cylinder.

Three hairs, 3, 3, 3, fixed to a micrometer screw, 4, 4, placed on the upper part of the instrument, and each stretched by a copper weight, descend into the cylinder, and pass through three holes, in a small horizontal plate, in order that they may be kept separate from each other.

On one side of the instrument is placed a small telescope, 5, having a wire in its field, for indicating, with great accuracy, the position of a mark on the copper weights, and ascertaining when the marks have descended to the same point.

The object of the micrometer screw is to measure the elongation of the hairs, which it does to nearly the 2500dth part of an inch, by the usual and well-known process.

In graduating the instrument, extreme dryness is obtained by means of sulphuric acid, and extreme humidity by means of aqueous vapour; and the elongation of the hairs in passing from the state in which they are saturated with moisture to that of extreme dryness, is measured by the micrometer screw. If this elongation is five millimetres, or about one-fifth of an inch, this space is represented by 100 degrees of the scale; so that $\frac{5}{100}$dths of a millimetre will correspond to one degree of the scale.

When the instrument is thus prepared for use, the glass cylinder is removed, and the hairs exposed to the air, the humidity of which will be indicated by the distance of the mark on the copper weight from the beginning or zero of the scale.

The advantages of this form of the instrument are thus enumerated by its inventor:

1. The extreme delicacy of the indications which is obtained by the telescope and the micrometrical screw, and by the use of three hairs, which are three hygrometers, the mean of the changes of which affords a much greater degree of accuracy than if a single one were used.

2. The removal of the error which arises from the friction and play of the axis of the needle in common hygrometers, as well as from the bending of the hair round the small pulley.

3. The facility of measuring the hygrometrical elongation of any substance, whether flexible or not, when reduced to a slender cylinder, and of comparing two hygrometric substances.

4. In this instrument, the three hairs, which are three hygrometers, agree nearly with one another, while two common hygrometers require very great precaution in order to agree with one another, even less perfectly.

5. This instrument becomes very portable by stopping the weights attached to the three hairs by a small pin which passes through them, and supports them while they are carried about.

Art. XVII.—*Account of the most recent Improvements on the Lunar Tables.* By M. le Chevalier Burg. In a Letter to Dr. Brewster.

Sir,

For some years past, I have devoted myself entirely to the task of perfecting my first determinations of the lunar orbit. My object has been to fix with all the precision, which perseverance and the use of the best materials could enable me to do, the elements which the lunar theory ought always to suppose given by observation. The results which I have lately obtained, are founded on the positions which Professor Bessel has deduced from the observations of Dr. Bradley for the year 1755, and from his own for 1815, on the axis of nutation, conformable to a great number of observations of the pole star, calculated by M. Enke; and on the obliquity of the ecliptic according to the determinations of Bessel.

On the supposition that you will take an interest in this subject, I shall communicate to you the results which I have obtained up to the present time.

1. The epoch of the mean longitude of the moon for the meridian of Greenwich and the year 1779, comprehending the secular equation, and exact to nearly *half a second*, is 2^{s} 12° 45′ 55″7.

2. The mean annual motion of the moon, between the years 1765 and 1794, is 4^{s} 9° 23′ 4″8195.

3. The equation of longitude depending on the oblateness of the terrestrial spheroid, is — 7″3. sin. suppl. ☊.

4. The epoch of the mean longitude of the supplement of the node for Greenwich, and the year 1779, comprehending the secular equation, is 9^{s} 10° 34′ 5″2.

5. The mean annual motion of the node, which, however, I give only as an approximation, is 0^{s} 19° 19′ 41″03.

6. The first equation of latitude is +5° 8′ 37″8 sin. Arg. lat. — 6″2 sin. 3 Arg. lat.

7. The second equation is +8′ 47″9 sin. [2 dist. ☾ *a* ⊙ — Arg. 1.]

8. The equation depending on the oblateness of the terrestrial spheroid, is — 8″6 sin. moon's true long.

9. The equation for correcting the supplement of the node, is — 8″.358 sin. ⊙ mean anomaly + 4″ sin. 2 ⊙ anomaly.

10. The equations of latitude refer to the old form of the lunar tables as given by Mason, which in my opinion ought still to be preserved. The rest of the equations of Mason's Tables differ very little from the determinations of theory, and do not seem to require any correction.

In reducing the observations made at Greenwich, it was of great importance to me to employ the semidiameter of the moon, which agreed with the telescope of the instrument, and I have been at great pains to verify this element. I have found it to be 0.273351 parall. by means of the series of observations from the year 1765 to July 1772, the epoch at which an achromatic object glass was adapted to the meridian telescope. For subsequent years I have found it to be 0.272993 parall. Burckhardt has adopted 0.27250 parall.

The method which I have followed has, however, this inconvenience, that the value of the semidiameter depends partly on the co-efficients of the variation. I have, therefore, sought to determine it also by the observations of the two edges of the lunar disc made at the time of full moon. If I shall be able to obtain a result, of which the accuracy is not doubtful, the first co-efficient of the variation will give me the parallax of the sun, and perhaps this element may be in this way obtained with not less certainty than it has been deduced from the two transits of Venus. However this may be, my researches seem to prove, that the semidiameter which Burckhardt has employed does not agree with the observations made at Greenwich; and it is besides very probable that the influence of the co-efficients of the variation which I have mentioned, will require rather an augmentation than a diminution of the lunar radius.

If I am spared for some years longer, I expect to be able to arrive at the solution of the question, Does there exist an equation of a long period which modifies the mean motion of the moon? The only assertion which I can permit myself to make at present is, that the equation, whose argument is 2 long. ☊ + ☽'s perigee, and employed by Burckhardt, ought to be suppressed in the construction of the lunar tables. For, independent of the circumstance, that the value which we obtain by analysis is insensible, the Tables represent best the observations made at Greenwich, from the year 1765 to 1794, when the equation above mentioned is struck out of them. It appears to me also, that the fundamental epoch of the mean longitude, adopted by Burckhardt for 1801, and retained by Damoiseau, is too small. According to my observations, it ought to be augmented by several seconds, which is also confirmed by the observations made at Greenwich in 1793. According to the Tables of Burckhardt, the epoch for that year will be $10^{s}\,26^{\circ}\,8'\,26''$; and the equation, whose argument is 2 long. ☊ + ☽'s perigee, $=0$; whilst 115 observations, which I have calculated for this purpose, give me $10^{s}\,26^{\circ}\,8'\,32''.3$. I have the honour to be,

Sir,
Your most obedient and humble servant,
J. T. Burg.

Vienna, *4th July*, 1824.

Art. XVIII.—*On a Simple Mechanical Method of Forming the Curves for Reflectors, and of illustrating the Principles of Various Philosophical Instruments, &c.* By Mr. John Hart, Civil Engineer. Communicated by the Author.

While engaged in drawing a curve for a gage, to enable the workman to form the reflector of the lamp for illuminating the dials of the Tron steeple of this city, an idea occurred to me of forming these curves, in a more simple manner than that usually practised. If a number of radii be drawn from a centre, on a sheet of paper, they will represent rays diverging from that centre; and if we fold them over in the direction that the light is required to take, the folds will represent the reflecting surface. Having found this method to answer upon trial, and to be more extensively applicable than I had at first supposed, I have sent it to you for insertion in your valuable Journal, under the impression that it may be of service to lecturers and teachers of youth, by affording a mechanical illustration of the properties of the conic sections, and other curves in the reflection of light or sound, &c. as well as to the practical mechanic, who may be unacquainted with geometry, but who may be employed in the construction of such instruments. The following is an abridgment of a paper read before the Glasgow Philosophical Society.

Before proceeding to curves, I shall give a few examples of its application to the angles of incidence and reflection, &c.

1st, A straight strip of paper simply folded, as shown in Plate XI. Fig. 1st or 2d, will give a correct idea of the angle of incidence and reflection; the strip represents the light before and after reflection; and the fold the reflecting surface; if two or three lines of different colours be drawn upon the paper, it will show how the image is inverted after reflection, as is shown in the plate by dotted and continuous lines.

Fig. 3. shows the construction and principle of the optical toy, called the *polemoscope;* the paper again represents the light and the folds, the angle of the mirrors.

Fig. 4. represents two folds or reflections, to produce a right angle; or, the principle of Dr. Wollaston's *Camera Lucida.* By holding the paper folded in this manner, between the eye and the light, the dotted lines will show how the object is erected by the second reflection in this beautiful little instrument, the folds, of course, represent the angle of the prism.

The Circle.—It is well known to geometers that rays of light falling on a spherical surface, (except from a luminous body placed in its centre,) will not meet in a point after reflection, but will have a number of distinct foci from every part of the circle: if a line be drawn through these foci, it will constitute a caustic curve. To illustrate this, take a piece of paper, see Figs. 5. and 6. and draw a number of parallel or diverging lines, about one-fourth of an inch asunder. From a point about the middle, describe a circle on both sides of the paper; then, with a knife, cut each alternate line, commencing with the cut a little within the circumference of the circle, and cutting to the end of the paper, these lines will represent parallel, or diverging rays of light; fold over the strips, making each fold upon the circumference of the circle: It will now be seen that these rays do not meet in a point, but cross each other in what geometers term *caustic curves.*

If all the parallel rays be folded so as to meet in the point where the first two rays crossed, as in Fig. 7. the curve formed by the folds will be a portion of a parabola.

The Ellipse.—If a luminous or sounding body be placed in the focus of an ellipse, the rays of light or sound will all be reflected to the other focus.

This may be shown by laying a narrow strip of paper from one of the foci, and folding it at any place upon the curve, it will point to the other focus. See Fig. 8.

Or by taking a few strips of paper of equal lengths, and pushing a pin through one end of them as a centre, and folding them so that each fold joins the last, and the other end points to another centre, the folds will form an ellipse round these two centres; thus clearly showing that every point of the curve reflects light or sound from one focus to the other.

The Parabola.—In order to form a parabolic curve, or a gage for a reflector that will reflect the light of a luminous body placed in its focus in a parallel stream, such as light-house reflectors, &c. Take a sheet of paper, see Fig. 9, and through the centre draw twelve or sixteen lines; let the centre represent a luminous point, (a candle for instance,) of course the lines will represent rays of light radiating from it. Take a knife, and cut each alternate line nearly to the centre, fold over one of the pieces, as in Fig. 10, making the fold at the same distance from the centre you want the focus of your curve to be, and the centre line of this fold to return over the centre of the radii, fold over the rest, making each successive fold to join with the last, observing always to make the centre line of each fold parallel to the centre line you first commenced with. The curve formed by these folds will be a parabola; the lines will represent the rays of light emanating from the luminous point, before and after reflection from the surface of the curve; or *vice versa*, parallel rays falling on this curve will be reflected to a point in the centre or focus.

The Hyperbola.—If the pieces be so folded, Fig. 11, that the lines be made to diverge, (so that if they were prolonged behind the curve they would meet in a point) the curve produced by the folds will be a hyperbola.

Therefore, if a luminous point be placed in the focus of this curve, the light will be reflected as if radiating from the point behind the curve, or its virtual focus.

It will be evident that parallel rays falling on this curve, will be reflected to its virtual focus; hence, if a hole be made through the centre of this reflector, and the virtual focus be placed close behind the curve, it will form an excellent burning mirror.

Reflectors for coach lamps may be formed either of this curve, with a distant vertical focus to spread the light a little before the horses, or of the parabola. It will be evident, however, that the parabola will likewise spread the light a little, as the flame is necessarily larger than its focus.

It must be obvious to those conversant with optics, that in this manner Gregorian, Newtonian, and Cassegranian telescopes, and reflecting microscopes, may be explained to a popular or mixed class, affording them a better idea of the proper curves for the reflectors of these instruments, than by the usual method of diagrams.

Upon a board, for example, draw the two specula and cone of rays of a Gregorian telescope, then take twelve or more strips of paper, and nail them in the focus of the great speculum; spread them out (like the rays of a fan) so as to cover the large speculum; now fold them up parallel, beginning at the centre of the great speculum to represent the incident rays. Turn down the other ends, beginning likewise at the centre of the small speculum, but converging so as to meet at its focus before the eye-glass. The difference of curves produced by the folds from the spherical draught upon the board will now be apparent, especially if the telescope is drawn of a large aperture, the slips of paper will give a distinct idea of the path of the light.

I shall now give an example or two of its application in Acoustics, and in forming the teeth of wheels, &c.

A long strip of paper folded, as in Fig. 12, will illustrate the nature of the *Speaking trumpet;* that is, the proper angle of the conical tube, in proportion to its length, to give the greatest number of echoes, or reflections, in lines, as nearly parallel as possible.

Fig. 13 is the converse of this principle, or the *Ear trumpet;* it will be seen, by inspecting this figure, that the dotted part of the cone must be cut off, otherwise the sound, after another reflection, would return back. Drawing two or three converging lines, and folding a strip of paper from side to side, as in Fig. 12 or 13, a workman unacquainted with geometry may determine the proper angle for any trumpet of this kind he may be employed to make.

As this method may likewise be used in finding the proper form of the teeth of wheels, wipers and stampers, irregular or eccentric wheels, &c. so that they may act fair, or roll upon one another, I shall give one example of its application to this purpose. Suppose that we have a half-worn wheel, and that it is required to find the form of teeth that will work properly into it: Take a slip of thin deal, and cut the form of one of the teeth of the wheel on the end of it, put a nail through it, at the distance of the centre of the wheel, so that it will describe a circle the same as the wheel; take another piece for the radius of the other wheel, place them at the proper distance, or pitch line; then take a piece of paper, and cut on it a few parallel strips, lay it on the piece representing the new wheel, as in Fig. 14, then move them forward, fold up the first strip that comes in contact with the teeth, observing to make the fold in a line with the acting surface; that is, fold the strip at right angles to the acting part of the opposite tooth, move it to the next strip, fold it up in the same manner, and so on till the tooth gets free. The curve formed by these will roll upon the teeth of the opposite wheel, whatever form they may have assumed by wear.

JOHN HART.

GLASGOW, *3d May*, 1824.

ART. XIX.—*On an Indelible Ink, and on Bistre.* By JOHN MACCULLOCH, M. D. F. R. S. F. L. S. and M. G. Communicated by the Author. (Journ of Science)

DEAR SIR,

THE perishable nature of our common ink is, as you well know, a frequent source of serious inconveniencies, particularly in the case of records, which it is important to preserve, if possible, for ever. The cause is too well known to chemists to require mention; and they also know the processes that have been recommended for the restoration of manuscripts which time has rendered illegible or obscure. In a minor way, we are often teased with the obliteration of our labels or memorandums of experiments in our laboratories, where acid vapours are often let loose so as to affect the atmosphere of these places. Mere damp, I need scarcely say, has the same effect of rendering writing, made in common ink, brown and indistinct; and the same effect sometimes arises from using a bad kind of this most indispensable substance.

Numerous projects for an indelible ink have been brought forward at different times; but none of these are effectual except where they contain powders that are exempt from the operation of the destroying causes. The ancients used charcoal in some form, as we have attempted to use lamp black, whether in that of Chinese ink or in some other shape. This is indelible, as is the ink of the cuttle fish, formerly used by the ancients, and still employed as a paint by modern artists, under the name of sepia.

But there are two objections to these powders, of whatever kind, which has hitherto prevented them from coming into general use. It is necessary that they should be mixed with glue or gum, without which they will not adhere to the paper. These substances, as well as the powders themselves, prevent inks of this nature from flowing freely through the pen, particularly in warm rooms, or hot weather; and hence the process of writing becomes tedious and irritating. They have another fault, of no small weight, namely, that in damp situations, they become mouldy, and are at length destroyed, so as to permit the powders to get loose, and the writing to be obscured or obliterated.

The substance which I have sent you is free from all these faults at least; although it still labours under some defects, which may perhaps prevent it from being generally introduced as an ink. Yet, as it is absolutely indelible, by acids as well as by time, it is worthy of attention, particularly in the cases above alluded to, where a little imperfection will be compensated by the advantages it holds out.

It is prepared from the substance called Bistre, the nature of which I formerly investigated in a paper published in the Transactions of the Geological Society.

This substance is a compound of carbon, or charcoal, and hydrogen, principally; very analogous to the bitumens, but differing from them in some particulars, which I need not here detail. It is most conveniently procured from the destructive distillation of wood, and can now be obtained, at no price, and in any quantities, from the distillers of charcoal for the gunpowder manufactories, and from the manufacturers of new vinegar.

When thus obtained, it is a liquid resembling common tar in consistence; and it is this substance which forms the beautiful brown varnish that covers the inside of a Highland cottage; being deposited from the smoke of the peat. On being subjected to evaporation or distillation, it gives out an essential oil, either colourless or brown, according as the process is managed, analogous to naptha and to petroleum, together with acetic acid. Being thus treated, it becomes first tenacious, like soft pitch, then hard or brittle, like asphaltum, with a bright, clean, conchoidal fracture. The longer the heat is continued, the more brittle it becomes, till at length it falls to powder.

The chemical change which here takes place is that of gradually diminishing the hydrogen in the compound; and, if the process be pushed to an extremity, charcoal alone at length remains. At the same time, the colour, which was at first a yellow brown, becomes gradually darker, till it settles into one that is nearly black.

In a hard state, this is the bistre of artists, although that substance is ignorantly obtained from the soot of wood, particularly beech, if possible; being generally furnished to the colourmen by the chimney-sweepers, who collect it from those places where wood is burnt. For this reason it is a very uncertain colour as to its tone; while artists also know well that it is often glutinous and disagreeable in use; adhering and returning to the pencil, so as to render it difficult to put on clear and repeated washes.

This fault consists in the evaporation not having been carried far enough; and, from the foregoing sketch of its nature, it will also be seen that the yellowish varieties will be the most disagreeable in working. The obvious remedy for these oils is to evaporate the oil and the acid; and that evaporation may be regulated to the greatest nicety, by adopting the liquid tar of the charcoal and vinegar distilleries. Thus it may be procured of the colour of sepia; which indeed it may be made to rival in use, as it is the same substance, considered as a chemical compound.

There is one other objection to the use of bistre, in water-colour painting, and that is its powdery nature; as it is, like other colours, merely suspended in gum. This evil is remedied by the same process which converts it into an ink.

It is soluble in the pure alkalies, both potash and soda; with which it forms a compound analogous to soap, and which is in fact the same, very nearly, as that which common rosin forms with these in that mixture of this substance with tallow which produces what is called brown soap.

But it must be remarked, that the combination with potash remains liquid, if not too far evaporated, while that with soda gelatinizes, even when much water is present. The process itself is extremely simple, as it consists merely in boiling the bistre in the alkaline solutions, taking care that they are fully saturated. The degree of dilution may be regulated at any time, according to the uses for which the colour is intended.

It is not easy to give precise directions for the state in which the bistre ought to be used, for want of a scale of reference. But it cannot well be too brittle and too dark in the colour, provided it has not been so far evaporated as to destroy its solubility. To bring it to the condition of asphaltum, is perhaps a good general rule.

In a fluid state, this is the indelible ink in question. There is no powder here, as the bistre is in a state of solution, and it requires neither gum nor any other addition. It remains unchanged in a bottle, never depositing its colour, like common ink. It flows freely through the pen, and can be used to write as rapidly as ordinary ink. It is so incapable of change as to resist even oxymuriatic gas; nor is it affected by any exposure to damp. I may add, that I have kept a manuscript for ten years, and more, exposed to the vapours of a large laboratory, where acid was always present, and where the paper was constantly damp, but without the slightest alteration.

Its defects are the following: It acts on the quill so as to blunt it rapidly, and to prevent the pens from giving fine hair strokes; no great evil compared to its advantages; and one which is obviated by the use of a metallic or a reed pen. It is more easily washed out by water than common ink; although it is difficult to discharge it entirely in this way, as it penetrates into the substance of the paper. This is a defect, however, to which all the powder inks are completely exposed, nor is it a trial to which manuscripts are likely to be subjected. Lastly, the colour is brown, and not black. If that is a defect to the eye, it is one that arises merely from habit. It is, notwithstanding that, more visible than ordinary ink; as artists well know that brown is a more powerful colour than black, and forms a much more *forward* colour, or offers a stronger contrast with white.

Such are its advantages and disadvantages; and I still think that the balance is so much in its favour, that it ought to be adopted for all public and legal documents, which it is so essential to preserve from obliteration.

This solution is also better adapted to water-colour painting than common ground bistre. It makes a clear wash, which is not disturbed by fresh application, and which does not deposit powder, that vice of Chinese ink which almost renders it useless in drawing. It has also the advantage of giving a degree of *forwardness*, or intensity, in the foreground, which cannot be obtained by common bistre; and, for this purpose, the solution in soda may conveniently be used, on account of the facility with which the paper may be loaded with it.

In terminating these remarks, I may add, that, in the use of common ink, it is an error to write with that which is blackest, although most agreeable to the eye at first. When rendered thus black, which it is by keeping, a portion of the tanno-gallate of iron has been deposited in the bottle, in consequence of the process of oxydation; so that the fluid, though darker, contains less of this salt than the pale ink which is fresh made. The more that can be applied to the paper, the longer it is likely to last; and thus, when the faint-coloured new ink is used, the greatest possible quantity is attached to it; while, in a few days, it becomes as black as if it had been used in that state from previous standing.

I am, yours truly,

To Dr. Brewster. J. MacCulloch.

Art. XX.—*On the Regular Composition of Crystallized Bodies.* By William Haidinger, Esq. F. R. S. E. Communicated by the Author. (Continued from No. I. p. 62.)

II. *Rhombohedral System.*

The regular compositions in the rhombohedral system in general may be divided into two great classes; such as consist of two individuals, the axes of which are parallel, and such as are produced by individuals, the axes of which form a certain angle. The first of these are pretty uniform in their appearance; they are very frequently found in nature, and are among those which, from the earliest times, have attracted the notice of mineralogists. The others are more varied, since the junction may take place parallel to different kinds of faces, which are inclined to the principal axes of the crystalline forms, and it has required more skill and a more intimate acquaintance with the products of nature, to find out in some of them the original simplicity of the individuals of which they are composed.

In the first case, the axis of revolution is always parallel to the rhombohedral axis of the form, or perpendicular to $R-\infty$; the plane of composition, however, may be either parallel to the same face, or it may be parallel to one of the faces of $R+\infty$, or even of $P+\infty$. Sometimes the substance of the individuals is continued beyond the face of composition; sometimes the composition itself is repeated parallel to that face. Of all these cases we have examples in Calcareous Spar, in which many of them have already been described by mineralogists.

If in a twin-crystal, the law of composition be expressed according to the method of Mohs, by $\{R-\infty\}$; that is to say, if the face of composition be parallel to the plane perpendicular to the axis of the individuals, the explanation given by Haüy will exactly correspond to the appearances. Haüy conceives, that in the *Chaux carbonatée metastatique*, which is $(P)^3 = 104° 38', 144° 24', 132° 58'$, Plate XIII. Fig. 1, a plane be laid through the points *a*, *b*, *c*, *d*, *e*, &c. and the lower part be turned round the axis for one-sixth of the circumference, while the situation of the upper part remains unchanged, so that after again having joined the two halves, an acute edge like X *m* will correspond to an acute edge like A *n*, while the obtuse ones like A *c* and X *e*, likewise fall into one and the same vertical plane. He adds, that this appearance might also be explained by a revolution of the half circumference, but that the other mode of considering the fact is more simple.* In respect to rhombohedral forms, an explanation of this kind might be adopted as a geometrical construction perfectly sufficient for the purpose. But it will be safer to comprehend this case also under the general law of a revolution of 180 degrees, that we may not in other cases find ourselves inclined to assumptions of a revolution of 90 degrees, for this does not correspond to nature, and has been improperly supposed to be the law to which certain varieties of twin-crystals might be referred.

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* *Traité*, 1re *éd.* t. ii p 136.

The mode of composition just now explained occurs very frequently, and with different modifications, in various crystalline varieties of Calcareous Spar. Those of the general aspect of a scalene six-sided pyramid (Fig. 2.) from Derbyshire, are well known, those of the combination of $R-1$ (g) and $R+\infty$ (c), Fig. 4. have been observed from Alston in Cumberland, from Maxen near Dresden in Saxony, and from other places. I have seen a very distinct crystal of a combination of $R-\infty$ (p), R (o) and $\frac{5}{4}R$ (h) Fig. 6. from the Hartz, in the possession of Mr. Sack of Bonn. The last of these varieties reminds the observer of certain regular compositions of the octahedron in Spinel, and of the combination H. O in hexahedral Lead-glance.* Figs. 3. and 5. represent the individuals contained in these two regular compositions.

If in the compound crystal of Fig. 2. the substance of the individuals be continued beyond the face of composition, the product will be nearly as Fig. 7. It is not uncommon to meet with a similar enlargement of the individuals, though it is generally found only in one or two of the solid angles of the crystal, and not so regular as in the figure. In the variety, Fig. 7. the acute terminal edges of one of the pyramids appear over the obtuse edges of the other. The reverse of it likewise occurs in the present species, the parts of the crystal joined to the alternating edges of one of the pyramids being sometimes contiguous to the acute ones, and presenting their obtuse edges at the outside of the twin-crystal, as represented in Fig. 10.

In the combination of $R-1$ (g) and $R+\infty$ (c) this same kind of enlargement gives rise to a very remarkable appearance, of which Fig. 8. represents a crystal from Alston moor in the collection of Mr. Allan. The parts c' c' belonging to one of the individuals, reach over the faces g, g, of the other; so that if we look at the composition from the apex, it seems as if it were composed of one central crystal, round which three others are aggregated from three different sides, which however may be joined by their substance reaching to the opposite side of the central individual. This junction is not a necessary circumstance; and therefore we are obliged to consider the whole as a composition of merely two individuals, even though the three parts joined to the central one be still separated from each other. The 9th figure represents a variety in some respects similar to the former, likewise from Alston, and in Mr. Allan's collection. It differs from the preceding one in the circumstance, that one of the individuals is much smaller, and as it were regularly implanted in the central part of the other. The faces of $R-1$ are in this variety very deeply streaked parallel to the edges of combination with R.

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* *Edinburgh Journal of Science, No. I. p.* 70.

Very often we observe plates of one individual engaged in an opposite sense in the other. Thus, in a compound crystal, of the form $(P)^3$ Fig. 11, the general shape of the pyramid is only as it were interrupted by that reversed film, and beyond it the faces again resume their former direction. If the composition be farther continued, a succession of plates is produced, not at all unfrequent in the species, and which gives rise to the varieties called Slate-spar, formed of individuals composed parallel to the face of $R-\infty$.

As the complementary mode of composition to the former it may be considered, if the two individuals, still in the position obtained by turning one of them round its axis, are joined in one of the faces of $R+\infty$. This mode of composition is analogous to that of the hexahedron in Fluor spar, where the individuals reach over the face of composition. The collection of Gratz contains $R+1$ compound parallel to one of the faces of $R+\infty$, Fig. 12, from the iron mines of Hüttenberg in Carinthia, the collection of Mr. Allan, the same from Faroe. We meet with this mode of regular composition, more frequently than in Calcareous spar, in another species of the genus Lime-haloide of Mohs, to which he has given the denomination of the *paratomous Lime-haloide.* This species is known in Stiria and Carinthia by the name of *Rosszahn* and *Rohwand*, and is sometimes called *White Iron-stone.* It contains a considerable proportion of carbonate of iron, along with which it occurs, and is melted with it as a valuable flux. The angle of the rhombohedron, parallel to which it may be cleaved, is $= 106° 12'$, its hardness $= 3.5$, the specific gravity, varies from 2.95 to 3.1; its colour generally is white, yellowish, or greyish, but it loses this colour soon, particularly on the surface, on being exposed to the action of the atmosphere, and becomes brown. Even the massive varieties of this species are often composed according to the law explained above, and allow forms of cleavage to be extracted from them which possess the appearance of Fig. 13, being two rhombohedrons joined parallel to one of the faces of $R + \infty$.

Red Silver-ore sometimes presents this mode of composition. I possess small crystals of the form Fig. 14, whose horizontal projection, referring like that figure to the single individuals, is Fig. 15. They are compound parallel to one, some of them parallel to all the faces of $R + \infty$; the horizontal projection of the first of these compositions is Fig. 16, that of the second Fig. 17. They are remarkably beautiful in their design, and in the regularity of the disposition of those edges in which the different simple forms meet, of which the combination consists. The simple forms are two rhombohedrons $R - 1$ (*z*) and $R + 1$ (*i*), four scalene six-sided pyramids, $(P - 2)^3$ (*l*), $(P - 1)^3$ (*a*), $(\frac{5}{4} P - 1)^3$ (*b*), $(P)^3$ (*h*), a six-sided prism $P + \infty$ (*n*), whose faces replace the lateral edges of the rhombohedrons or pyramids, and a three-sided one $\frac{R + \infty}{2}$ (*k*), appearing in the place of the alternating edges of *n*. Not having observed the opposite apex of the crystals, I have given the sketch only of the upper one, the alternate appearance of the faces *k* being sufficient to indicate that the opposite ends may be of a different configuration, as is the case in Tourmaline, which indeed we have often occasion to observe in other varieties of the present species.

Regular compositions according to the same law are pretty general in Cinnabar, a species which constitutes, together with the preceding one, the genus Ruby-blende of Mohs. The two individuals either terminate at the face of composition, as in Fig. 18, or they reach to a certain extent beyond it, as represented in Fig. 19. The latter is the more common occurrence in the regular composition of this species.

The variety of rhombohedral Iron-ore, Fig. 20, first noticed, I believe, by Mr. Breithaupt of Freiberg, from the tin mines of Altenberg in Saxony, is very nearly allied to the preceding one of Cinnabar. It is particularly remarkable that the faces *n*, *n′* of the two individuals, belonging to the isosceles six-sided pyramid P + 1, coincide in one and the same plane, while the faces of the rhombohedron R form re-entering angles, starting from every one of the apparently continuous faces of that pyramid. The splendid tabular crystals from Stromboli very often show this kind of composition, taking place, however, in but a single plane of R + ∞. The simple individuals of which they consist possess the form of a combination R — ∞. R . P + ∞, Fig. 21, the compound crystals in which two individuals are joined, parallel to one of the faces of R + ∞, assume the appearance of Fig. 22, in which very often it is either entirely impossible to see the lines of junction *a b*, *b c*, &c. or it requires the most accurate inspection, because the faces *o* and *o′*, and the faces *z* and *z′* fall into one and the same plane. The exactly reversed situation of the faces of R (*P* and *P′*), in respect to the plane of junction, then remains the only means of discerning the simple and the compound varieties in these crystals. Sometimes it is possible, however, to discover slightly-marked triangular figures disposed in an opposite direction upon the faces of R — ∞, produced by striæ which betray the composition. The 23d Figure represents a crystal of this kind, with the striæ above mentioned, which is preserved in Mr. Allan's collection, together with several others of the preceding form and composition.

Chabasite is another species, frequently occurring in regular compositions. If we conceive two rhombohedrons in a transverse position to be united with each other, we shall obtain the most common of these compositions, (Fig. 24.) which, together with several others, were first described by Professor Weiss.* The varieties from the Giant's Causeway, of the form R — 1. R. R+1. P+ ∞, join into forms like Fig. 25, where the diverging striæ upon the faces of the prism indicate the composition, even if we do not attend to the re-entering angles along the inclined faces of the compound crystals. Dr. Brewster has found, that what is here supposed to be an individual, is composed in a very remarkable symmetrical manner, of particles that possess each of them two axes of double refraction. It will be necessary, therefore, to subject the forms to a new crystallographic examination, before it be possible to adopt the determination of Haüy, who first attributed the regular rhombohedral form to this substance.

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* *Mag. der Ges. Nat. Fr. zu. Berlin*, vii. p. 181.

The regular compositions of two individuals, whose axes are parallel, assume a peculiar character in some of the hemi-rhombohedral forms, or those in the combination of which the simple forms enter only with half the number of their faces. The axotomous Iron-ore of Mohs, and rhombohedral Quartz, are the only examples of this kind as yet observed. The species of axotomous Iron-ore was first determined by means of the varieties of the black titaniferous oxide of iron from Gastein in Salzburg. It has not been as yet generally adopted as a peculiar species by mineralogists, if the Crichtonite of Count Bournon does not perhaps form one of its varieties, of which however the properties are too imperfectly known, to allow us to form a decided opinion. The simple crystals of this Iron-ore are similar to those represented in Figs. 26. and 27. one of them containing $R-\infty . R . \frac{r}{l} \frac{P+1}{2}$, the other $R-\infty . R . \frac{l}{r} \frac{P+1}{2}$. Their junction produces Fig. 28, a compound form, which resembles very much certain varieties of rhombohedral Iron-ore, as for instance those from Framont, the fundamental rhombohedron, as measured by the reflective goniometer, being $=85° 59'$. The composition generally takes place parallel to $R-\infty$; but the substance of the individuals is continued, not always in the most regular manner, beyond the face of composition, or even alternating in parallel layers. In the 28th figure, the two individuals have been supposed to meet in faces parallel to $P+\infty$, which pass through *a b c*, *a d e*, &c. For the sake of furnishing some distinctive characters between this species and rhombohedral Iron-ore, it will be sufficient to add, that its specific gravity is considerably lower, having been found in a perfect crystal $=4.664$. Its hardness is likewise inferior to that of rhombohedral Iron-ore, being $=5.0 \ldots 5.5$, or rather higher than that of Apatite. The colour and streak are black, and the lustre imperfect metallic. It acts slightly upon the mag-

-netic needle. It is found in the valley of Gastein and several other places in the Alps, at Klattau in Bohemia, and Ohlapian in Transylvania. It is generally accompanied by Rutile, upon the crystals of which it often forms a coating.

Several of the twin crystals of Quartz have been described in a very interesting paper by Professor Weiss,* particularly such as result from the union of individuals in the whole length of their axis, in which the termination presents the alternating planes, *P*, *P*, &c. of the isosceles six-sided pyramid considerably larger than the rest, which in some instances entirely disappear. Fig. 29. represents a group of Amethyst from Brazil, in the collection of Mr. Allan, consisting of two individuals thus joined in one of the faces of R + ∞. In another variety, Fig. 30. in the same collection, from the Vendyah mountains in Hindostan, the alternating planes of the pyramid have entirely disappeared. This variety deserves particular notice, on account of the appearance of the inclined faces *q*, *q′*, on both sides of the faces of P, the situation of which, however, it has been impossible to determine exactly, on account of their being curved, and thus beyond the reach of a goniometer. If the individuals are continued over the face of composition, those varieties arise, which Professor Weiss mentions to have projecting solid angles of the one individual upon the faces of the other, and of which some examples occur along with the preceding ones in the same group of white transparent crystals lining the inside of an agate ball. There exist also varieties composed in the plane of R — ∞, and of these a very distinct solitary twin crystal is contained in the Wernerian collection at Freiberg. Professor Weiss has already pointed out the extraordinary way in which the plagiedral faces of scalene six-sided pyramids occur in the species of rhombohedral Quartz. As it is represented in Fig. 31. which refers to a group of clove-brown crystals from Brazil, in Mr. Allan's collection, curiously contorted in the direction of these faces, the faces *u* do not appear in the alternating solid angles between the isosceles pyramid and the prism, but they appear on both sides at the corresponding solid angles, so that they are situated with perfect symmetry to the right of *P*, and to the left of *s*, if considered on both terminations of the crystal. We have often occasion to observe compositions of two of these individuals in the manner represented in Fig. 32. The appearance, however, is very seldom so regular as it is represented in the figure, but all our figures represent indeed only the *beau ideal* of the crystal, restored to its geometrical regularity, which it necessarily must lose by the disproportionate enlargement of the faces, and by that of the substance of the individuals in respect to each other, as also by the contact in which it comes with other minerals.

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* *Mag. der Ges. Nat. Fr. zu. Berlin*, vii. p. 163.

All the appearances in the regular compositions of rhombohedral Quartz, as enumerated above, may be traced to the first general law of composition, which requires one of the individuals to be joined to the other in a certain plane, after having been revolved round a given line through 180 degrees; although they likewise allow of an explanation according to the second law, which is limited to such combinations as present half the number of faces of certain simple forms. But if a left and a right individual of rhombohedral Quartz join in a regular composition, only the last of these laws will be applicable, because it is impossible to produce the one from the other by merely inverting it, or changing its position. The particles of one individual alternate in this case generally in their films with those of the other, disposed in the direction of the faces both of the isosceles six-sided pyramid, and of the six-sided prism. In this state they have been discovered by Dr. Brewster in Amethyst,* which name since that time has not been restricted as formerly to the violet-coloured varieties, but likewise applied to those of a yellow or green colour, or even of a perfectly colourless transparency, which are composed of the two individuals recognisable by their opposite action upon polarised light.

Regarding these two varieties of Quartz, thus distinguished not only by their action upon light, but also by their crystallographic properties, which cannot be joined by transitions with each other, but present an abrupt termination on one or the other side of the respective individuals, it has been questioned, whether it would not be more conformable to the natural historical idea of the species in mineralogy, to keep them separate from each other as two different species. It seems that well-founded objections may be raised against this mode of considering the matter, derived from the occurrence of the kinds of forms in the two varieties. There exists a general geometrical construction, by which we may obtain the tetrahedron from the octahedron, consisting in the process of enlarging the alternating faces of that form which is to be resolved. It is evident that two tetrahedrons are thus obtained, of which the one is in the inverse position of the other. In like manner, we obtain two pentagonal-dodecahedrons from every hexahedral trigonal-icositetrahedron, the one in the inverse position, and as it were complementary to the other.* In these cases we may obtain the one from the other, merely by bringing it in an exactly opposite position. The same will hold true in two similarly shaped crystals of Tourmaline, however composite in respect to the number of simple forms they contain, if brought into the inverse position. In this species, moreover, opposite kinds of electricity are united with the different configuration on opposite ends; and the crystals of Tourmaline therefore represent the same relation in another species, except that by merely inverting the one individual, they may be brought in parallel positions. The opposite kinds of electricity are a physical property of Tourmaline connected with its form, exactly as the action upon light is connected with the form of the crystals of Quartz. If we apply the above-mentioned process of resolution to the scalene six-sided pyramid, Fig. 33, whose faces occur in the combinations of the latter species, we obtain solids by enlarging alternating pairs of faces *u* and *u*, or *u′* and *u′*, &c. which are indeed those trapezohedrons, turned as it were to the right, fig. 34, and to the left, fig. 35, which likewise result from the enlargement of the plagiedral faces in the two different varieties of Quartz. The geometrical process cannot produce a right trapezohedron without yielding at the same time a left one, and it appears that even though we had never met with one of the two kinds of Quartz, we should yet have been entitled to suppose its existence, solely on account of the method by which they both result from the scalene six-sided pyramid. The two kinds of Quartz have been very often, and with propriety, compared with the right hand and the left, less aptly perhaps in respect to the determination of the species, with shells having their volutions disposed to the right or to the left. The cones of *Pinus sylvestris* yield an exactly analogous instance in the vegetable kingdom, the scales being disposed in spiral lines, turned as it were in some to the right, in some to the left, without on that account producing a difference in the species.

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* *Trans. of the Royal Soc. of Edinburgh*, vol. IX. p. 139.

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* *Edinburgh Journal of Science*, No. I. p. 71.

The faces of composition between right and left individuals of Quartz are difficult, if ever, to be observed; in fact, the particles of the individuals present various irregular faces to each other, though it appears from their exact position that they are joined according to a determined law. If we have not occasion to observe the inclined faces, like *u*, or *u′*, we remain often uncertain whether the individuals joined be exactly similar or inversely similar to each other, though the compound state of the crystals may be completely established.

That the faces of composition between the two individuals are not always parallel to some face of crystallization, at least not to any considerable extent, will appear with perfect evidence from a consideration of Fig. 37, which represents a twin-crystal of perfectly transparent Quartz, from Dauphiny, in the possession of Mr. Allan. It is one of the variety accompanying the well-known large crystals of Calcareous spar. In another crystal of Quartz, but a simple one, likewise from Dauphiny, and in Mr. Allan's collection, nearly of the form of the simple ones in Fig. 29, the alternating faces of P+1, marked *x* are rough, and almost without lustre, so that they reflect a red image of the sun or other luminous objects, while the remaining faces of P+1 marked *P*, are perfectly smooth, and reflect a white image. The faces *r* likewise are smooth and reflect a white image, whereas the surface of the rhombs, which replace the edges *s*, approaches more in its properties to the surface of *x*. Now Fig. 37, of which Fig. 38 is the projection upon a horizontal plane, is a composition of two individuals possessing the same properties in regard to surface, joined with parallel axes in a transverse position. The parts of the faces marked *P*, *x*, &c. belong to the individual nearer the axis, *P'*, *z'*, and to that which takes the greater part in limiting the compound crystal in the directions perpendicular to this line. The whole has so much the appearance of a simple crystal, that it requires to be accustomed to meet with compositions of that kind, even to suspect the compound state of a crystal so perfectly transparent as the one represented. The part *a* upon one of the faces presents striae of smooth and rough lines, just as in the figure, produced by alternating particles of the two individuals. Even upon the faces of the prism we find traces of composition, though very slight, being perceptible only from a want of continuity in the crystal in the direction of the lines between *r* and *r'*, Fig. 37. It is deserving of notice, that the smooth parts of the faces are rather more elevated than the rough ones, which becomes observable on passing a sharp knife over them, which meets with some resistance on arriving at the smooth particles.

Another very remarkable composition of a similar kind was pointed out to me by Mr. Allan, likewise in a transparent Rock crystal, in his cabinet. In this variety, as represented in Fig. 36, the faces of the prism *r* possess a damask-like appearance, if the reflection of light be properly managed. The parts marked *r* and *r'''*, in fact, consist of a succession of planes slightly inclined towards the upper apex, while *r'* and *r''* are produced by a similar succession of planes inclined towards the lower apex. Thus delicate striae are formed over all the face of the prism, but the situation of the planes becomes evident on examining the surface, parts of which alternately give a bright reflection while the rest appear of a darker tinge. The portions marked *r* and *r'* belong to one individual, *r''* and *r'''* to the other. Also upon the faces of the isosceles pyramid, faint traces of composition may be discovered, depending upon a slight difference in the degree of polish of the faces belonging to different individuals. The cross fracture of this, and of the preceding variety, presents that velvety appearance which has been described by Dr. Brewster in the last number of this Journal.

(To be continued.)

ART. XXI.—*Tables of the Variation of the Magnetic Needle in different parts of the Globe.*

THE following Table forms the last of the series of valuable Tables of the Magnetic Declination given in Hansteen's interesting work entitled, *Untersuchungen uber den Magnetismus der Erde,* which appeared at Christiania, in 1819. We have added several new determinations in New South Wales, from Major Oxley's *Journals of Two Expeditions into the Interior of New South Wales, in* 1817 *and* 1818.

TABLE.—*Containing the Variation of the Needle as observed in the South Sea, including Australasia.*

NAMES OF PLACES.	Year of Observation.	Magnetic Variation.
Amboyna,	1792	1° 14′ E.
Anamooka,	1643	6 20 E.
	1774	9 47 E.
	1777	8 30 E.
Admiralty Island,	1767	6 30 E.
Admiralty Bay, N. Zeal.	1773	14 30 E.
Botany Bay,	1770	8 0 E.
Bathurst, N. S. Wales,	1817	8 40 E.
Port Macquarrie, do.	1818	10 5 E.
Loadstone Hill, do.	1818	6 22 E.
Long. 144° 34′ E. Lat. 33 53 S. do.	1817	7 25
Long. 140° 20′ E. Lat. 30 57 S. do.	1818	8 42
Long. 146° 0′ E. Lat. 34 14 S. do.	1817	8 0
Bourn Isle, Cayeli,	1613	0 54 W.
	1799	0 18 E.
Boscawen Island,	1767	9 0 E.
Cocos Island,	1795	5 14 E.
Cumberland Island,	1767	7 0 E.
Charlotte Island,	1767	5 20 E.
Cook's Strait, N. Zeal.	1773	15 2 E.
Christmas Island,	1778	6 22 E.
Charlotte Sound, N. Zeal.	1773	14 0 E.
Ship Cove,	1774	14 9 E.
Diemen's Land,	1777	12 4 E.
Adventure Bay,	1642	0 0 E.
Ditto do.	1773	10 0 E.
Ditto do.	1777	5 15 E.
Cape Diemen,	1788	8 33 E.
Ditto do.	1792	7 40 E.
Dusky Bay, N. Zeal.	1793	7 25 E.
Pickersgill Haven,	1773	13 49 E.

NAMES OF PLACES.	Year of Observation.	Magnetic Variation.
Pickersgill Haven,	1793	14° 56′ E.
Dory Haven, N. Guinea,	1775	1 30 E.
Erromango Island,	1774	10 6 E.
Eaowe Island,	1773	9 3 E.
Easter Island,	1774	4 30 E.
	1786	3 10 E.
Egmont Island,	1767	6 0 E.
Espiritu Santo Island,	1774	10 29 E.
Farewell Cape, N. Zeal.	1773	12 12 E.
Gallipagos Isle,	1794	8 0 E.
George's Cape, N. Ireland,	1767	5 20 E.
George's Canal, N. Brit.	1767	4 40 E.
George III.'s Sound,	1791	5 20 W.
Grafton Island,	1765	1 20 W.
	1767	1 3 W.
Gloucester Island,	1767	7 10 E.
Gower's Island,	1767	8 20 E.
Howe's Island,	1767	7 40 E.
Heiligen 3 King Island, N. Zeal.	1643	8 40 E.
Huaheine,	1773	6 31 E.
Owharree Haven,	1774	5 20 E.
	1777	5 13 E.
Julias Island,	1800	2 50 E.
Kotoo Island,	1777	8 12 E.
Keppel Island,	1767	10 0 E.
Lefooga Island,	1777	10 12 E.
Luçon Island, Manilla,	1766	0 15 W.
Cavite,	1787	0 33 W.
Maitea,	1788	5 36 E.
Mercury Bay, N. Zeal.	1769	12 40 E.
Morder Bay, N. Zeal.	1642	9 0 E.
	1770	13 5 E.
Mowee Island,	1786	8 42 E.

TABLE—*continued.*

NAMES OF PLACES.	Year of Observation.	Magnetic Variation.	NAMES OF PLACES.	Year of Observation.	Magnetic Variation.
Norfolk Island, .	1774	11° 3′ E.	Castle Point,	1788	8° 30′ E.
New Caledonia, .	1793	9 30 E.		1795	11 9 E.
New Guinea, W. Point,	1643	5 30 E.	Pilstart Island,	1643	7 30 E.
Otaheite, S.E. Point,	1767	6 0 E.		1773	9 51 E.
N.E. Point,	1767	5 30 E.	Palliser, Cape N. Zeal.	1770	14 0 E.
Point Venus,	1769	4 45 E.		1773	13 1 E.
Ditto ditto,	1773	5 40 E.	Scilly Island, .	1767	8 0 E.
Ditto ditto,	1774	5 49 E.	Saumder's Island,	1767	6 30 E.
Matavai Point,	1777	5 34 E.	Savage Island, .	1774	11 25 E.
——— Bay,	1794	6 12 E.	Tolaga Bay, N. Zeal.	1773	13 40 E.
——— ditto,	1795	3 43 E.	Tongataboo, .	1643	7 15 E.
Ohittahoo, .	1774	2 31 E.		1773	10 11 E.
	1791	5 30 E.		1777	9 58 E.
Osnaburgh, .	1767	6 0 E.	Tinian, .	1793	10 0 E.
Onehow, .	1796	10 54 E.		1767	6 20 E.
Owhyhee Karakakoa Bay, .	1774	8 6 E.	Turtle Island, .	1774	12 28 E.
	1793	7 47 E.	Tanna, Port Resolution,	1774	7 14 E.
	1796	8 15 E.	Ulietea, .	1773	6 10 E.
Observatory Island, N. Caledonia, .	1774	10 24 E.	Ohamaneno Harbour,	1774	6 14 E.
			Ditto ditto,	1777	6 19 E.
Palmerston Island,	1774	10 1 E.	Woatoo, Fairhaven,	1796	9 41 E.
Pitcairn Island, .	1767	2 46 E.	Waygiou, .	1775	1 0 E.
Pudyana Island, .	1774	8 33 E.		1793	1 14 E.
Pescadores Island,	1767	10 0 E.	Whitsunday Island,	1767	6 0 E.
Pulo Aroe, .	1767	1 0 W.	William Henry, Pr. Isl.	1767	7 0 E.
Port Jackson, N. Holland	1770	8 0 E.	Wallis Island, .	1767	10 0 E.
			York Island, .	1767	6 0 E.

ART. XXII.—*Observations on the Rate of a Chronometer, when under the influence of Magnetism.* By GEORGE HARVEY, Esq. F.R.S.E. M.G. &c. Communicated by the Author.

ON reviewing my paper on the influence of magnetism on the rates of chronometers, published in the 19th number of the *Edinburgh Philosophical Journal,* I find there are some striking peculiarities relating to the time-keeper A, which seem to merit a farther examination.[*]

By a reference to the Table of Rates contained in the sixth page of the essay here alluded to, it will be perceived that the different directions in which the magnetic influence operated on the time-keeper, produced alterations of rate, remarkable for their magnitude and diversity, and the results of which I have endeavoured more particularly to illustrate by means of the accompanying figure.

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[*] This chronometer was in my possession only for a short time, and I was, therefore, prevented from performing all the experiments I intended with it.

The brass case of the chronometer is denoted by the circle XII, III, VI, and IX, Plate IX. Fig. 2. S being its main spring, and B its balance; and by referring to the radial lines, AO, BO, DO, EO, FO, HO, KO, and LO, it will be perceived that they respectively represent the directions in which the magnetic force operated on the machine during the different experiments; their positions also being more particularly designated by means of the degrees representing the measures of the arcs, which compose the dotted or external circle. The line LO, for example, passing through the centres of the time-keeper and main-spring, indicates the direction of the magnetic force which produced the maximum acceleration; and HO, forming with the line connecting the centres of the balance and chronometer an angle of 27°, that in which the maximum declension of rate took place. So also the radial line KO, forming with LO an angle of a like magnitude, is that in which was produced a variation of rate, bearing to the maximum acceleration the same ratio that the daily aberration in DO, forming likewise with the radial LO produced an angle of 27°, does to the daily increment produced in the radial EO.

By referring to the rates determined in the positions BO and DO, and which were respectively —2″.6, and +33″.7, it is evident that, in the translation of the magnetic force, from the former direction to the latter, through the arc BD of 63°, a considerable augmentation of rate was produced; and it is therefore probable, that at some intermediate point of the arc, a daily rate might have been obtained, which should coincide nearly with the mean detached rate of the chronometer, or +20″.4. In like manner, by comparing the rates in the directions FO and HO, it is equally probable that a similar point might have been found in the arc FH; and so also may a third have existed, between the points H, K, and a fourth, in some part of the arc LA.

In the sixth page of the paper before quoted, it is observed, "that the removal of the centre of the spring, from the axis of the magnet, through equal arcs, appeared to have produced proportional declensions of rate;" or by a reference to the figure in question, that the translation of the attractive force, from the direction LO to KO, occasioned a declension of rate, proportional to that produced, by changing it from EO to DO; and although a similar proportional declension of rate could not be satisfactorily traced in the other directions in which the magnetic power operated, there is evidence sufficient to warrant the conclusion, that four points at least existed in the circumference of the timekeeper in question, through which, had the magnetic force been propagated, in directions proceeding to its centre, the daily aberrations of the machine would have coincided nearly with its rate, when detached from the magnet; and that, moreover, two of these lines of detached rate, are to be found in that half of the chronometer represented by the semicircle III, VI, IX.; and in which very nearly the whole of the balance is situated; and the other two in the remaining portion of the timekeeper, and in which the major part of the main-spring is to be found.

If, in order to afford a more perfect illustration of the case in question, the proportional declensions of rate before alluded to, be supposed to uniformly prevail, from any one of the positions in which the attractive force operated, to one that is adjacent to it, we may obtain a more definite idea of the probable positions of the lines of detached rate. Suppose, for example, it be required to determine the situation of the line of detached rate, between the points B and D, which include an arc of 63°, according to this hypothesis. It will be found that its direction is in the line CO, forming with the radial DO, an angle COD of 23°.4; since 33″.7 + 2″.6 : 63° : : 33″.7—20″.4 : 23°.4 nearly. In like manner, the position of a similar line, in the arc FH, will be found to be in GO, forming with FO an angle FOG of 4°.5, for 29″.1 + 23″.2 : : 27° : : 29″.1—20″.4 : 4°.5 nearly. So also its situation in the arc HK, will be found by a like process, to be in the line IO, forming with the direction KO, an angle IOK of 25°.9, for 50″.8+23″.2 : 63° : : 50″.8—20″.4 : 25°.9 nearly. And the fourth line of detached rate MO, will be found to form with AO, an angle AOM of 20°.5, since 68″.9—18″.5 : 63° : : 20″.4—18″.5 : 2°.5 nearly.

The relative positions of these lines of detached rate, merit however some further attention. In the *first* place, the line of detached rate between the points H and F, forms very nearly the same angle with the line HO, that the similar line between the points B and D does with the direction DO. Nor is the difference between the arcs CD and IK very considerable, the lines of detached rate CO and IO being nearly opposite to each other; or practically speaking, forming an angle of about 24°, on opposite sides of the line joining the hours of III. and IX. It may also be regarded as singular, that the other lines of detached rate GO and MO should be so nearly opposite to each other; and that the sum of the rates in the directions AO and KO should approach so nearly to equality with the rate in the direction LO.

Considering the variations of rate as uniformly constant in the several arcs above determined, it may be interesting to compare the different degrees in which the rate changes in different parts of the circumference of the chronometer. Commencing, for example, with the rate of change in the arc BC, we shall have 39°.6 : 23″ :: 1° : 0″.58; that is, an acceleration of rate takes place in the arc BC, proportional to + 0″.58 for a degree. In like manner, for the arc AB, we shall have 27° : 21″.1 :: 1° : 0″.78; or that a diminution of rate is produced in the arc AB, proportional to — 0″.78 for a degree.

According to this principle, the following Table has been constructed: the first column denoting the arc; and the second, the rate according to which each degree of the arc changes, on the supposition that the variation of rate is uniformly constant, the signs + and — indicating whether the rate is accelerated or retarded.

Arc.	Variation of Rate for each Degree of the Arc.
BC	+ 0″.58
CD	+ 0″.57
DE	+ 0″.36
EF	— 0″.23
FG	— 1″.93
GH	— 1″.94
HI	+ 1″.18
IK	+ 1″.17
KL	+ 0″.67
LM	— 0″.80
MA	— 0″.76
AB	— 0″.78

From the preceding Table, it therefore appears that the alteration of rate produced in the quadrantal arc BE is distinguished by a positive character; in the quadrant EH by a negative; in the quadrant HL again positive, and in LA again negative. Of these rates of change, the greatest is that in the first quadrant from B to D; in the second from F to H in the vicinity of the balance; in the third from H to K; and in the fourth from L to M.

PLYMOUTH, *June 26.*

ART. XXIII.—HISTORY OF MECHANICAL INVENTIONS AND PROCESSES IN THE USEFUL ARTS.

1. *Brown's Atmospherical Engine.*

WE have seen a model of a pump in which the air in the barrel was rarefied by burning the shavings of wood at the top of the barrel, an airtight cap being put on when the rarefaction was supposed to be at a maximum. A certain quantity of water was thus raised above the valve at the bottom of the barrel, and the operation was repeated till the water rose to the desired height. Though this expedient might be found useful in cases of exigency, it had not a sufficiently practical character, and we have not heard of its being introduced.

An analogous though totally different principle has been happily applied by Mr. Samuel Brown to create a vacuum in pumping engines, which may be employed both to raise water and drive machinery. The specification of the patent by which Mr. Brown has secured his right to this invention, was enrolled only in June 1824, so that we are not able to speak of this invention on the authority of any actual trial of it on a large scale. The principle, however, of the invention is highly ingenious, and we are disposed to view it as a formidable rival to the steam engine in its best form.

In its general character of an atmospherical engine, Mr. Brown's invention resembles the steam engines of Savary and Newcomen, but the vacuum is effected by burning coal or oil gas within the cylinder, so as to consume the atmospheric air.

The general appearance of Mr. Brown's engine is represented in Plate IX. Fig. 16, where *a* and *b* are the two cylinders in which the vacuum is to be produced, *c* and *d* two rising mains leading from the reservoir *i* to the top of the cylinders *a*, *b*. Coal or oil gas is conveyed from a gasometer through the pipes *e e* and *f f*, the last of which pass into the cylinders, and terminate in the perforated burners *g*, while the pipe *e* terminates in small openings with sliders *h h*, in the sides of the cylinders *a* and *b*, immediately opposite to which are lateral jets, communicating with the burner *g*.

The reservoir *i* is filled with water, which, by passing through the pipe *j* into *k*, raises the float *l*, and by pushing up the rod *m*, elevates the end *n* of the beam *n z*. The cap *o* will thus be lifted from the cylinder *b*, and the cap *p* brought down upon the cylinder *a*. By opening the stop-cocks, the gas is to be let into the pipes *e* and *f*, and the jets at both ends of the pipe *e*, near *h* and *h* are to be set fire to. The slider *h* having been lifted by an arm *g*, moved by the ascent of the rod *m*, the flame of the jet *e* instantly communicates with the burner *g*, and causes it to burn within the cylinder. In the upper part of the apparatus, there is placed a small cylindrical glass vessel *r*, which is more than half full of mercury. It vibrates on pivots, and as the rod *m* ascends or descends, two small arms *s*, fixed to the rod *m*, strike a pin on the side of the mercury vessel, and thus raise and depress it alternately. The mercury being thus made to flow to the lower side gives motion to certain minor parts of the engine, as will be afterwards explained.

In the position of *r* in the figure, the rise of the end *s* of the vessel has by the rod *t* drawn the slider *v* over the mouth of the pipe *j* and closed it, opening at the same time the mouth of the pipe *u*. The water thus flows from *i* into *w* and into *d d*, forcing the float *x* to ascend and lift the rod *y*, which raises the end *z* of the beam, and takes the cap *p* from the cylinder *a*, while it places the cap *o* air-tight on the cylinder *b*.

. By this descent of the end *n* of the beam the rod *m* is brought down, which, by the intervention of the arm *y* shuts the slider *h*. As the gas at *g* is now burning within the closed cylinder *b*, the air is consumed during the combustion, and a vacuum produced. The water, therefore, rises, as in a pump in the main *d*, and flows over the top into the cylinder *b*, which is thus nearly filled, the rarefied air escaping through small valves in the top of the cylinder.

During the process, the returning stroke of the beam and the vessel *r* has shifted the slider *v* from the mouth of the pipe *j* upon the mouth of *u*, and by the same operation formerly described, the rod *m* and the end *n* of the beam are raised, by which means the end *z* descends and places the cap *p* on the top of its cylinder, and the gas in the cylinder *a* turns and raises the water into the cylinder in the manner already described.

In order to raise the caps off their respective cylinders *a* and *b*, after a vacuum has been made in them, a small quantity of air is admitted by a slide valve in the air pipe A, which is worked by chains BB attached to the floats *l x*, and by means of the lever *z z* to which the slide above A is attached, the ascent and descent of the floats admits the air alternately into the cylinders *a* and *b* immediately after the water is risen.

The gas is turned off and on by chains C, C, with suspended weights, passing from the ends of the vessel *r* to the stop cock in the gas pipe *f*. The water raised by the engine is retained by the valves at D, D, and it occupies the mains and the outer cases of the cylinders which keeps the interior cool; but the greater portion of the water that is received into the cylinders *a*, *b*, passes off through pipes EE to the trough F, from which it is delivered through a sluice into the buckets of a water wheel GGC, which it drives, and from the axle of which any kind of machinery may be driven. This wheel is unnecessary when the machine is to act merely as a pump.

The inventor remarks, that a piston may be worked on the principle of producing a vacuum beneath it by burning the air in the manner above described; and he proposes that this be done in a distinct vessel, so as to communicate with several cylinders, and consequently to work several pistons at once; the air and vacuum valves being opened and shut by the same means as the induction and eduction valves in steam engines.

Mr. Brown proposes to impel steam boats with this engine, which, he says, will require only a few butts of oil for a long voyage.

Among the advantages of this engine are its small size, which is only one-fifth the weight of a steam engine and boiler of the same power, and its entire freedom from danger.—See Newton's *Journal of Arts and Sciences*, vol. viii. No. 44, p. 57.

2. *On the Process of Cutting Steel with Soft Iron.*

We already had occasion to notice the remarkable practice of the Shakers in America of cutting the hardest steel with a revolving wheel of the softest iron. Mr. Perkins repeated the experiment in London, and since that time it has excited general notice in every part of Europe. Dr. Hare of Philadelphia, and Mr. Whitney of Newhaven, have both made experiments on the subject to a considerable extent; and Professor Silliman, who witnessed these experiments, considers the process as " only a peculiar method of cutting *red hot* or possibly *white hot* steel, for the mechanical force produces these degrees of heat, and the steel loses its temper at the place of action."—Silliman's *Journal*, vol. vii. p. 342.

The most careful investigation of this curious process has been made by M. M. Darier and D. Colladon of Geneva, and the following seem to be the principal results of their experiments:

1. Having found that the iron wheel was covered with small fragments of the steel, they could see by a microscope no appearance of softening; on the contrary, they found these fragments as hard as the best tempered steel.

2. Having fitted up a lathe by which they could give a determinate velocity to the iron wheel, they found that with a velocity of 34 feet per second, an iron wheel was easily cut by a steel graver without any reaction on the graver. With a velocity of 34 feet 9 inches the iron was less attacked, and the graver began to experience an impression from the iron. At a velocity of 35 feet 1 inch, the action of the iron on the graver was decided, and increased with greater velocities, till at a velocity of 70 feet per second, the iron was no longer touched by the steel, while the steel was cut with the greatest violence.

3. In order to determine the effect of softening or annealing on the steel, our authors examined the fragments of steel detached from the graver at different velocities, from 40 to 100 feet per second; and in every case when the iron was only touched for an instant with the steel graver, the latter exhibited no trace of annealing; but when the graver was long and strongly pressed, it sometimes became red hot. In that case, however, the fracture of the steel became quite different, and *the action upon it was rather diminished than increased.*

4. Having thus ascertained that the effect is not owing to the annealing of the steel, and found that the effect was not increased by the frag-

ments of steel, which after some time collect on the iron wheel, our authors justly suppose that the whole effect is directly mechanical, arising from the brittleness of the steel, which is torn asunder before it has time to introduce itself among the molecules of the soft iron; and they consider it as analogous to the penetration of wood by a ball of tallow.

5. Upon using wheels made of a mixture of copper and iron, and wheels of pure copper, no effect was produced by them on the graver, though they cut different alloys harder than themselves.

In these experiments, however, a very remarkable effect occurred. *Little or no heat was generated, when files and steel springs were held firmly against the revolving copper wheel,* and our authors observed several other curious facts, which they mean to study with greater care connected with the production of heat by the friction of metals.—See *Bibliothèque Universelle,* Avril 1824, p. 283—290.

3. *On the Effect of Animal Charcoal in preventing the Putrefaction of Stagnant Water.*

M. A. Chevallier, of Paris, having been consulted by a gentleman respecting the best method of preventing a pond in his garden from putrefying, recommended the employment of animal charcoal. The experiment was tried with perfect success. The small pond or basin was about nine feet in diameter, and three deep. The water proceeded from a spring; but towards autumn it became putrid, and exhaled a mephitic odour. On the 10th of August, 1823, 45lbs. of animal charcoal in powder were thrown into it, care being taken to spread it equally on the surface, where it at first floated, but afterwards fell to the bottom. The effect of this was to remove all offensive smell from the water; and M. Chevallier, upon examining a bottle of it, found that it had neither an offensive smell nor taste, though it had been out of the pond for eight days.

M. Chevallier observes, that the animal charcoal which has been thus used in a pond, might, when taken out, be employed as a manure, as it gives out by slow degrees to vegetable bodies the substances which it has absorbed. See the *Journal de Pharmacie for* 1824, p. 73.

4. *Hughes' Improvement in the Gudgeons of Water Wheels and Cranes.*

According to the present method of fixing the gudgeons or pivots into the wooden axles of large wheels by means of an iron cross let deeply into the wood, and held fast by wedges driven round it, the gudgeons are not only liable to heat in working, but they soon get loose, and are split and rendered useless.

Mr. Hughes' improvement, for which he has received a silver medal from the Society of Arts, consists in applying to the end of the axle a cast iron box, and to this box is screwed the iron cross of the gudgeon. On the end of the box there is a projecting flaunch, and on the face of this, four grooves or notches are made for the reception of the arms of the iron cross which forms part of the gudgeon. This cross is firmly attached to the cross by four screw bolts, which pass through the flaunch, and also through the ends of the arms of the cross, having nuts screwed on the outside to make all fast. The hoops and cast iron gudgeons in the old method cost £6, 16s. whereas the expense of the present improved one is only £4, 16s. See the *Transactions of the Society of Arts*, vol. xxxi.

5. *M. Bunten's Improved Syphon.*

The improved syphon of M. Bunten is shown in Plate IX. Fig. 17. where AB is the long branch, with a bulb at A, and DC the short branch. This syphon requires neither to be blown into, nor any suction. It is sufficient to fill the long branch AB, and the ball A, with the liquid, and to plunge the short branch CD into the liquid to be decanted. The bulb A, in emptying itself, draws off the liquid in contact with the short branch, and though the bulb itself is partly empty, the flow is unremitting.—See the *Journal de Pharmacie, Avril* 1824, p. 189.

6. *M. Hempel of Berlin's Improved Syphon.*

Another improved syphon by M. Hempel, a practical chemist at Berlin, is shown in Plate IX. Fig. 18. It has the same advantages as that of M. Bunten, and is more easily constructed on a large scale. A part of the liquid to be decanted is poured into the funnel A, at the top of the tube AB, which is fitted into the short branch of the syphon. As soon as the flow commences through the long branch DC, the tube AB is withdrawn, and the flow continues.—*Id. Id.*

7. *New Method of Bleaching Flax and Hemp.*

The flax and hemp being broken and cleaned, and laid in bundles of less than a pound weight, are to be immersed for six hours in a solution of slaked lime, of the consistency of whitewash. When the lime is discharged from the fibres by clean water, the flax is then to be boiled in water, with about 4 oz. of pot or pearl ashes, for nearly six hours, fresh water being supplied when necessary.

During the process of boiling, the flax must be taken out and put back into the alkaline solution, to disturb its colouring matter, and, when it is sufficiently boiled, it will feel slippery between the fingers. It is now to be washed in clean water, and again put into a solution of lime as before, repeated agitation being employed. It may now remain in the solution at rest for six hours, and, when it is washed with clean water, the fibre will be left pure, but with a slight yellow tinge.

In order to remove this tinge, plunge the flax in a weak solution of sulphuric acid and water, and after keeping it there for three hours it will be found to be of a pure white, and when passed through the hackle is ready for use.—See Newton's *Journal of the Arts*, vol. viii. p. 87.

8. *Sir H. Davy's Method of protecting Copper Sheeting from Corrosion by Sea Water.*

The distinguished President of the Royal Society of London had long ago shown, that the chemical action of bodies upon each other may be modified or destroyed by changes in their electrical states; that substances will combine only when they are in different electrical states; and that by bringing a body naturally positive, artificially into a negative electrical state, its usual powers of combination are altogether destroyed. By reasoning upon this general principle, which had previously conducted him to many brilliant discoveries, Sir Humphry was led to the discovery which we propose at present to explain. Copper being a metal only weakly positive in the electro-chemical scale, he conceived that it could only act on sea water in a positive state, and consequently that if it could be rendered slightly negative, the corroding action of sea water upon it would be destroyed. After many trials, he obtained the most satisfactory confirmation of these theoretical views. A piece of zinc as large as a pea, or the point of a small iron nail, preserved 40 or 50 square inches of copper from corrosion, whether it was placed at the top, bottom, or on the middle of the sheet of copper, and whatever was the shape of the copper. Every side, every surface, and every particle of the copper continued bright, while the zinc or the iron was slowly corroded.

A piece of thick sheet copper, containing about 60 square inches of surface, was cut, so as to form seven divisions, connected only by the smallest filaments, and a mass of zinc, of the fifth of an inch in diameter, was soldered to the upper division. The whole was plunged under sea water, and after the lapse of a month the copper was as bright as when first introduced, while similar pieces of copper undefended had undergone considerable corrosion.

The application of these results to the preservation of the copper sheeting of ships of war and other vessels is obvious. Under the sanction of the Lords Commissioners of the Admiralty, Sir Humphry has been engaged in ascertaining the value of this discovery upon ships of war, and we learn with the happiest effect. Sir Humphry has, we believe, found that the defended copper is more liable to become foul by the adhesion of barnacles, weeds, &c. than the undefended, because the oxide on the latter poisons the animals, whereas the clean metallic surface does them no harm. It will be necessary, therefore, as we believe Sir Humphry has suggested, "to weaken the defensive action by diminishing the extent of defending surface to such a point as to allow a slight oxidation of the copper sufficient to repel the animalculæ, but not sufficient to occasion a serious waste of the metal."—*Ann. of Phil. Aug.* 1824. In another paper, our author proposes to describe other applications of the principle to the preservation of iron, steel, tin, brass, and various useful metals.

We cannot conclude this notice without adverting to a most singular attempt which has been made to deprive this eminent philosopher of the merit of his discovery; an attempt, however, which, except among the ignorant, can have no other effect than to exalt the genius of the individual whom it is meant to injure. Because Mr. Charles Wyatt of Birmingham took out a patent in 1791 for tinned copper sheets, and recommended *tinned copper* for the sheathing of *ships*, on account of the tin resisting the action of salt water, it is therefore boldly averred that

Sir H. Davy's invention is not original. Those who wish to read an answer to this ridiculous claim, may consult the *Ann. of Phil.* Aug. 1824, p. 141. Sir Humphry Davy's paper is printed in the *Phil. Trans.* for 1824, No. I. page 151–159.

ART. XXIV.—ANALYSIS OF SCIENTIFIC BOOKS AND MEMOIRS.

I. *Esquisse de Voyage au Pole Austral, et autour du Monde, sous la conduite du Capitaine Bellinghausen.* Par M. SIMONOFF.

Sketch of the Voyage to the South Pole, and round the World, performed in 1819, 1820, *and* 1821, *under Captain Bellinghausen.* By M. SIMONOFF, Astronomer to the Expedition.

As the detailed account of this interesting expedition, by Captain Bellinghausen himself, has, so far as we know, not yet appeared in any language, we propose to gratify our readers with a general account of it, very slightly abridged from a series of letters on the subject, published by M. Simonoff, in the *Correspondance Astronomique* of Baron Zach.

The author of these letters accompanied the expedition in the capacity of astronomer, and such was his activity and zeal, that the Emperor of Russia appointed him, on his return, to the Professorship of Astronomy, and to the charge of the observatory in the university of Kasan, along with the decorations of two orders, and a pension for life of 150 ducats annually.

This expedition, the object of which was to make discoveries in the Antarctic Ocean, and to advance as near as possible to the south pole, was intrusted to Captain Bellinghausen, who had accompanied Admiral Baron Krusenstern in his circumnavigation of the globe. The expedition consisted of two vessels, the *Wostok* and the *Mirni*, which were supplied with astronomical and philosophical instruments from London. All the officers and ships' company were Russians, selected by the commander himself, and the only foreigners who were to accompany the expedition were two German naturalists, who promised to join the expedition at Copenhagen, but who unfortunately broke their obligation, when the Captain had it no longer in his power to supply their place.

The Wostok and the Mirni set sail on the 3d July 1819, and arrived at Copenhagen at the end of ten days. From this port they set out on the 20th July, and reaching Portsmouth on the 29th, M. Simonoff went to London to receive the instruments which the Minister of Marine had ordered for the expedition. After a delay of fifteen days, the expedition quitted Portsmouth, and arrived at Teneriffe.

M. Simonoff, accompanied by three officers, ascended the celebrated peak, which they had seen at the distance of 120 miles.* The environs of the mountain he considers as delightful and beautiful beyond all description, and he was gratified at observing, in the Botanic Garden, plants from every region of the world thriving in the most surprising manner.

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* The inhabitants declare that the peak is seen from the Bocayna, or the canal between the Islands of Fortaventura and Lancerotta, a distance of 160 sea miles.

Quitting Teneriffe on the 19th September, they reached, after a voyage of 42 days, Rio Janeiro, where they met the Russian expedition, under Captain Wasilieff on its way to the North pole. The Portuguese government assigned to them the *Ilia de Rados,* opposite the town of St. Sebastian, for the purpose of regulating their chronometers, and making the observations for the longitude and latitude.

After a stay of 20 days, the expedition quitted Rio Janeiro, and after passing the tropic, the ships were continually enveloped in the thickest fogs.

"On the 14th Dec. 1819," says our author, "which corresponds to the 14th June of our climate, the first snow appeared, in the latitude of 52°. On the 15th June we arrived near Southern Georgia, and from that time we had to struggle against innumerable dangers and misfortunes of every kind. The island of Georgia is covered with ice and eternal snow. The northeast side of the island having been visited and described by the immortal Cook, we surveyed the south-west coast, which had never before been explored.

On the 17th December we passed Clerk's Rocks, and on the 22d we discovered an island to which Captain Bellinghausen gave the name of the *Island of the Marquis de Traverse,* * (in honour of the Minister of the Russian Marine.) This island, of which we made a survey, has a volcanic peak, from which columns of smoke are continually discharged.

On the 27th, we passed, at the distance of 30 miles, the *Isles de Rencontre,* which a dead calm prevented us from approaching.

On the 29th we arrived near the islands which Captain Cook called *Sandwich Land.* † This great navigator had, from a distance, considered the Capes Saunders, Bristol, and Montague as belonging to a great continent, but we have carefully surveyed them, and found that what was taken for terra firma was only a mass of small serrated islands, more dreary, and even more barren than the island of Georgia. On the last island, however, we observed here and there a green moss; but in the islands of the *Marquis de Traverse* and of *Sandwich,* even this stunted vegetation is no longer seen. The sea which washes these shores is covered with huge masses of ice, and whales, penguins, and other sea birds are the only inhabitants of these desolate regions.

The survey of the Sandwich Islands occupied us till the 4th January 1820, when we penetrated beyond 60° 30′ of south latitude crossing in parallel directions to the 59th degree, from whence we proceeded to the south, and arrived at 69° 30′ of south latitude, where we were stopped by a barrier of impenetrable ice. In all this course, even to New Holland, the Sandwich Isles (Sandwich Land) was the only land which we encountered. During this long navigation, we wandered in the midst of fogs, and in a labyrinth of floating icebergs, which sometimes were elevated 300 feet above the level of the sea, and threatened every moment to overwhelm us. Cold, dampness, snow, tempests and storms never quitted us for one moment in this difficult course. The only amusement which we had was in the contemplation of the southern lights, which we always witnessed with pleasure and admiration.

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* In south latitude 56°, and long. 31° 30′ west of Greenwich.

† The winter in Sandwich Land is considered as more frightful than even in the coldest regions of the north. An interesting account of it will be found in Espinosa's *Memoria sobre las Observaciones Astronomicas hechas por los Navegantes Espanoles.* Madrid, 1809.

This light shows itself suddenly on the southern horizon, in the form of a moveable white column. In its rapid shiftings it displays the finest colours of the rainbow; it illuminates all the horizon, and suddenly vanishes, only to reappear under a thousand other forms, which keep up the same play of colours. This fine spectacle amused us every night, from the 2d till the 7th March, when the sky was darkened with clouds, and the wind gradually rose into a tempest, so furious that the oldest sailors in the expedition had never seen any thing similar to it. The vessels laboured, and bent under the raging waves in the most frightful manner, and shipped much sea at their sides. The sails were torn in pieces, and, to add to our misfortune, we found ourselves within two fathoms of an immense mountain of ice, against which we would inevitably have been dashed to pieces, had not a large wave thrown us back, and thus saved us from instant destruction. Our situation was the more distressing, that we could look for no human aid in these desolate seas.

Our faithful companion the Mirni, who had always followed us till now, had parted from us on the 5th of March. Captain Bellinghausen had sent it to cross in a direction parallel to our course in the lower latitudes, and it was to join us in New Holland. Fortunately we had now passed in a great measure through the region of countless icebergs, which had encircled us from the 3d to the 7th March; and if the storm had overtaken us there, our loss would have been inevitable, or we should, at least, have suffered the most serious distresses.

The rapid approach of winter now announced to us that we must not think of advancing farther to the south. We therefore availed ourselves, on the 19th, of a favourable wind, which carried us at the rate of ten or twelve miles an hour; and, directing our course to New Holland, we came in sight of Van Diemen's Land on the 24th; and on the 30th March we anchored in Port Jackson, opposite the town of Sydney. After a fatiguing and perilous navigation of 130 days, Port Jackson seemed to us a paradise. The Mirni arrived there seven days after us.

The town of Sydney, the chief place of the colony for convicts transported from England, may already be compared with the finest cities of Europe. Straight and wide streets, well-built houses, churches, hospitals, theatres, magazines, fine gardens, well-cultivated fields, bespeak the industry, the culture, the commerce, and the prosperity of that thriving colony. It has flourished greatly under the administration of the late Governor Macquarrie, who built hospitals, barracks, prisons, workhouses, manufactories, and schools, in which are not only taught reading, writing, and accounts, but also the principles of religion and morality, and even several trades and professions. Agriculture and commerce flourish; and even now, vessels laden with the productions of the country export them to China and the East and West Indies. The effects of this are visible in the comfort and happiness which appear among several classes of the population, for there is a great number who have settled voluntarily in the colony, and who constitute the class of honest and respectable citizens. The convicts whose term of exile has expired, and their children, are gradually incorporated with them, and often become very honest and useful members of society.

The government has found it impossible to civilize the natives of this country. Some of them, however, begin to feel the benefits of civilization. They send their children to Sydney, to schools expressly established for their instruction, and the parents seem to derive pleasure, and even importance, from their progress; but they themselves are unable to abandon their idle and wandering mode of life, living like brutes in the woods, where they have neither fire nor habitations.

Notwithstanding this these people are quite harmless. During the time of my stay at Port Jackson, I resided in a tent on the shores of the bay opposite to the town, and not far from the forest which these savages frequented. I went several times unarmed into their great assemblies; and though they were often intoxicated, I never received from them the least insult or act of hostility. The English likewise allow them to enjoy perfect tranquillity, and do them all the good in their power. The natives carry fish to the village, which they exchange for wine, to which they are much addicted; but I speak only of the natives who live in the neighbourhood of Port Jackson, for those in the interior are said to be cannibals, and often attack the colonists who are established at the foot of the Blue Mountains.

The rapid progress of this colony leads us to anticipate that New Holland, equal in extent to all Europe, will become a powerful state, like that of North America; though the want of navigable rivers, and the consequent difficulty of inland communication may be an unsurmountable obstacle to the colonisation of that vast territory. Our stay at Port Jackson was prolonged to thirty-eight days. The friendly reception we experienced from the English, the kindness shown to us by the governor, and the attention and politeness with which we were loaded by the commissary-general, and in short, by every person employed in that colony—merited our warmest gratitude; and we quickly forgot all our past sufferings and dangers, in the obliging and hospitable treatment which we received. The governor supplied us with the means of repairing our vessels, which stood in much need of it, especially the Mirni, which had received very considerable injury from a large iceberg.

During our stay here, I was constantly employed in astronomical observations, whenever the weather permitted it; and, besides the usual occupation of regulating the chronometers, &c. I determined the position of several stars in the southern hemisphere, which had not been observed since the time of the Abbé de la Caille.*

We had scarcely lost sight of the shores of New Holland, which we quitted on the 8th May, when we were assailed by a furious wind. Captain Bellinghausen at first intended to make for the equator, but a contrary wind, which obstinately pursued us, not permitting this, we directed our course to New Zealand, which we had proposed to revisit. This storm, which lasted till the 19th May, was succeeded by a dead calm, but the rolling of the sea was frightful. A huge wave, which had struck our starboard, and carried away the ballustrade, and every thing which it found, had nearly swept off Lieut. Ljeskow, who was saved only by clinging to some of the rigging.

After some days we perceived the Blue Mountains of New Holland. We tacked about with a good breeze, and entered Cook's Straits. On the 28th May we watered in Queen Charlotte's Sound, behind the Long Isles, opposite to Matura.

The natives speedily visited us, and as we invited them on board, they came and exchanged their cloths, their wooden spears, their stone scissars, and their hooks of stone and shell, for our nails, knives, axes, mirrors, and other trifling articles.

The New Zealanders are of a middle size, and of a robust structure. Their faces are tanned, full of expression, and tattoed with various figures. They have a great degree of vivacity, and their eyes display much martial spirit. Though they conducted themselves very peaceably towards us, as the strongest, we were on our guard against being surprised. We, therefore, never landed without a strong escort; a precaution which we deemed the more necessary, as we had heard of recent instances of their perfidy; and we well recollected the cruelties which they had shown towards the French Captain Marion, and to ten men of the crew of Captain Furneaux, who had been here with Captain Cook.

The views of the coast are highly picturesque, with lofty mountains entirely covered with dense impenetrable forests. The weather was fine during our stay, excepting on the 2d June, when a furious storm arose, and raised the waves to such a degree, that we were obliged to throw out a second anchor.

We spent only five days in New Zealand, occupied in regulating our chronometers, and in surveying the island of Matuara and a part of Queen Charlotte's Sound.

After a navigation of eight days we perceived the solitary island of Oparo, the mountains of which have a very singular conformation, being very narrow at the base, very pointed at the summit, and wholly covered to their top with lofty trees. The natives came to us in their canoes, and brought us lobsters and other provisions. They are of the middle size, of a copper colour, and possess an extraordinary degree of vivacity. They go quite naked. One of these wished to accompany us. He had firmly resolved upon this; but when he saw his companions return, and leave him behind in the vessel, he was seized with a love of home, threw himself into the sea, and swam to his countrymen in the canoes.

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* Sir Thomas Brisbane has since determined the positions of more than 10,000.

On the 5th July we came in sight of a low coast covered with trees, and, upon approaching it, we found it to consist wholly of coral, without any inhabitants. We next entered the archipelago of the *Dangerous Islands*, near which we discovered another group of islands, quite unknown, to which Captain Bellinghausen gave the name of the *Archipelago of Alexander I.* The inhabitants of these islands are entirely savages, and the most ferocious that we have yet encountered. They absolutely wished to have no communication with us. They set fire to their forests, in order to terrify us, and prevent us from landing. The captain endeavoured to allure them to the ships, by expressing, in signs and gestures, our friendly dispositions, and by exhibiting to them and offering them several presents; but all these inducements were in vain. We at last tried to frighten them, by firing muskets in the air. They seemed to believe that we wished to exterminate them by fire: They exhibited water, and scattered it in showers, as if to show that they could extinguish our fire. The captain did not wish to use force, and returned on board his ship.

From the Archipelago of Alexander I. we sailed for Otaheite, where we regulated our chronometers, in order that we might reduce the longitudes of several islands that we had discovered in our last course.

Since 1815 this island has been wholly converted to Christianity by the English missionaries, but it was not without many severe struggles and sufferings of every kind. Pomary, the actual chief of this island, was the first who, with some of his connexions, embraced the Christian religion, which gave rise to a bloody war. The new converts were defeated, driven from the island, and obliged to take refuge in Eimeo. Here Pomary collected new forces, attacked Otaheite, and brought the whole island under his dominion. He recalled the missionaries, and built a great church, in which he thus harangued his people:—

"If I had adhered to my ancient religion, I would have slain you all, and driven you from the island; but the Christian religion, which I have embraced, teaches me to love and to pardon my enemies, and therefore I love and pardon you."

This conduct made such an impression on the islanders, that they were all converted to the true faith; and from that moment peace and harmony reigned in the island.

The Missionaries, who are continually occupied in civilizing and instructing the people, have invented an alphabet for the Otaheitean language, and have translated the Gospels of St. Matthew and St. Luke. They have taught the children to read and write, and to sing hymns and Psalms.

In setting out from Otaheite, we passed before the Island of Krusenstern, discovered by Kotzebue: we made more than 10 degrees in longitude; and, as the season approached for making a second excursion to the Icy Sea, we directed our course to Norfolk and Howe Islands, in order to return again to Port Jackson, where we arrived on the 8th September.

Our second excursion into the regions of ice was not less difficult and dangerous than the first. We completed this perilous navigation in 124 days, and in that period we discovered seventeen new islands.

All these islands resemble each other. Their bases are banks of coral, covered with fruit trees of the finest appearance, in the middle of which the palm tree raises its majestic head. All the inhabitants of these picturesque islands belong to the Malay race. Their tint is copper-coloured; —and their language, though rudely pronounced, is soft, and abounding in vowels. Their habitations are huts, encircled with pallisades, and covered with herbs and the leaves of trees.

Although the inhabitants of a country, with so fine a climate, and so fertile a soil, may live happily, yet they wage continual war with each other. Eternal enmities reign among the different races of the people, and the strongest give the law to the weakest, with a cruelty beyond all description. We had the satisfaction of saving the lives of four boys, who had escaped from the hands of their persecutors: we took them on board our ships, and carried them to Otaheite, where they were received in the most amicable manner.

With the exception of Otaheite, we have only met with one unknown island whose inhabitants we distinguished from their neighbours by a remarkable sweetness of temper. This island is in the neighbourhood of the Friendly Islands, and is called *Ono.* We stopped there two days, during which several chiefs of the island passed the night on board with a degree of frankness and security which we had never before met with.

The principal occupation of these islanders is fishing. Those who have had any communication with Europeans, fish pearls, but only in a small quantity.

Their manual labours consist in making mats, of a species of stuff woven out of the bark of trees. These stuffs are commonly white, but sometimes they give them a yellow colour, with a plant of the genus Polypodium.

The Otaheiteans are also occupied in making butter from the oil of the cocoa nut. They cultivate leguminous plants, roots, fruit trees, orange trees, lemon trees, ananas, and bread-fruit trees.

The pleasure of a voyage in a climate so mild and abounding in every thing, is a little diminished by the burning heat of the sun, and sultry weather, and by the great number of coral reefs which surround these islands. One evening, when we were very near the Island of Ono, we heard the sea groaning, so as to indicate the breakers of a reef: the warning was fortunately in time, and we escaped from certain destruction by quickly turning about the ship. The survey of the new islands which we had discovered, and their geonomical determinations, terminated the labours of this voyage.

In the course of the voyage I have made many physical observations. During 161 days, from the 2d July, when we entered the tropical region, till the 1st September, I observed, at all hours of the day and night, the state of the barometer, thermometer, and hygrometer. The barometer rose every day gradually to its highest point, and fell very slowly to its lowest point. This rise and fall took place twice every 24 hours. The barometer reached its maximum height at 9h. in the morning, and 9h. in the evening; and it came to its minimum height at 3h. in the afternoon, and 3h. in the morning. In our climates this phenomenon is not perceived; but under the tropics, and in the open sea, where the air is more free and more homogeneous, the heat more uniform, and the winds more regular, it shows itself with more regularity, because it is not opposed by changes, and by extraneous causes. During our stay between the tropics, and at Rio de Janeiro, we made more than 4316 particular observations.

At Port Jackson we were received by the English with the same hospitality as before, and having finished our business in that port, we set out on the 31st October, directing our course right south to Macquarrie Island, where we arrived on the 17th November, and found a number of English whale ships.

Here we felt, for the first time, an earthquake at sea, the shocks of which were very strong. The whalers, who were on the island, felt it also three different times. Earthquakes, we understood, take place there every month.

We continued our course to the south-east, sailing between large masses of ice; but notwithstanding all our efforts, we never could pass the 70th degree of south latitude, and this only in one place. In all others we could only advance to 69½°, and the ice was there 300 fathoms thick. *

The second polar voyage was much more perilous than the first, and it was only to Divine Providence, and the vigilance of our captain, that we owe our safety. On the 25th December, 1820, when we were assembled for divine service to return thanks to the Almighty on the anniversary of the victory which we had gained before Paris, we struck with great violence against a huge mass of ice; but fortunately the shock was oblique: the ice only grazed the part of the vessel where the anchors were suspended, (and which was for this purpose provided with a double parapet,) which was carried off by the violence of the shock; but the ship suffered no injury, and showed no mark of leakage.

After having encountered so many dangers, we had at last the satisfaction of making several new discoveries. On the 11th January, 1821,

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* This is certainly a large number of fathoms; but it stands so in the original.

we discovered, in 69° 30′ of south latitude, an island, which we called *Peter I.;* and on the 17th of the same month we fell in with a coast in the same latitude, which we named *Alexander I.* These lands are encircled with ice, which prevented us from approaching them, and examining them more narrowly. The discovery of these islands is the more remarkable, as they are the most southerly of all the lands that have been discovered in that hemisphere.

We next directed our course to New Shetland, which consists of several islands. We surveyed the southern coast of it, and discovered six other islands. They are, however, all uninhabited, barren, and covered with snow and perpetual ice. They are only the abode of penguins and whales.

From hence we set sail to New Georgia, and terminated our navigation of the Icy Sea to the south of the same island at which we began our researches, having often passed the polar circle, and having sometimes remained there more than 15 days, which no navigator had ever done before us. We made the complete tour of the polar circle, and we returned to this island from the west. The celebrated Cook has said, in one of his voyages, "I have navigated the southern hemisphere under different latitudes, with the view of demonstrating that there is no great continent, unless, perhaps, in the polar regions, into which, however, we cannot penetrate." We succeeded in penetrating into it in several places: we passed the southern polar circle, and navigated the seas beyond it, which nobody had done before us; and if the coast of *Alexander I.* is not part of a continent, we may say, in confirmation of the words of Cook, that we have met with no trace of this pretended polar continent.

We have enlarged our geographical knowledge by the discovery of more than 30 new islands; and besides many useful and important observations in several branches of science, we have enriched our museums with many new and rare productions of the three kingdoms of nature.

From New Georgia we sailed to Brasil: we arrived at Lisbon on the 17th June, 1821, and anchored in Cronstadt on the 24th July.

Such is a brief account of our expedition, which lasted two years and twenty-one days. Although we were twice more than 120 days in very unhealthy seas, yet, out of 200 persons, we lost only three sailors: one fell from the top-mast and was instantly killed; another fell into the sea in a dark and stormy night, and was swallowed up by the waves; and the third died of a disease which was incurable on land as well as at sea."

II.—*On the Anhydrous Sulphurous Acid, and on its application to the Liquefaction of some other Elastic Fluids.* By M. Bussy, of the School of Pharmacy.

This very interesting paper was read at the Society of Pharmacy in Paris, on the 15th March 1824, and is published in the *Journal de*

Pharmacie for April 1824. Independently of the value of this Memoir, it may be considered as confirming the experiments of Mr. Hutton of Edinburgh, who succeeded in the year 1810, in freezing alcohol at the specific gravity of .798. As Mr. Hutton did not publish his method, in consequence of his using it in his extensive manufactory of artificial salts, some doubt was entertained respecting his experiments; but those who had opportunities of knowing the talents and scientific resources of that gentleman never doubted the reality of his results. These results, too, are described with a minuteness of detail which no sagacity could have anticipated; and we doubt not that the process of congelation discovered by M. Bussy, when brought to higher perfection, will either completely establish or overthrow the detailed results given by Mr. Hutton.

M. Bussy's Memoir is so interesting, that we shall gratify our readers by a translation of the whole of it.

" Having been led, by researches in which I was engaged, to suppose that anhydrous sulphurous acid could be obtained liquid by a simple diminution of temperature, I made some experiments which confirmed this opinion. I had at first believed that a considerable reduction of temperature would be necessary, and I consequently collected the gas in very powerful frigorific mixtures; but I soon found that a mixture of *two* parts of ice with *one* of muriate of soda was sufficient to liquify completely the gas without losing the smallest quantity.

" The apparatus which I employed consisted of a matrass, in which I put equal parts of mercury and sulphuric acid. This mixture served to produce the gas, which first passes into a vessel surrounded with melting ice, in order to condense the greater part of the water which it might carry along with it. It afterwards passes into a long tube, filled with fragments of fused muriate of lime, and it finally passed into a small flask, surrounded with the cooling mixture, where it condenses itself into a liquid with the pressure of the atmosphere.

" When obtained in this manner, the liquid sulphurous acid enjoys the following properties: It is colourless, transparent, of the specific gravity of about 1.45, and it boils at the temperature of 10° below zero, (14° Fahr.) It is, however, easily preserved at the ordinary temperature, even for a long time, because the portion volatilized produces a cold sufficiently considerable to reduce the temperature of the rest below the point of ebullition. When poured on the hand, it produces a sharp cold, and completely evaporates. When poured drop by drop into water, at the ordinary temperature, it occasions a species of effervescence, owing to the volatilization of part of the acid, *the temperature is lowered, and the surface of the water is covered with a thick crust of ice.* When it is poured out carefully, it never mixes with the water; and in this case it collects at the bottom of the vessel in the form of drops, like oil that is heavier than water. If it is then touched with the extremity of a tube, or any other body, it is suddenly converted into gas, and causes a kind of ebullition in the liquid.

"Presuming that the cold produced by the evaporation of the acid must be considerable, I surrounded with cotton, the bulb of a mercurial thermometer, and after having poured upon it some drops of the acid, I agitated it in the air. The mercury descended regularly to 35° or 36° below zero, (—32° Fahr.) but when it reaches this point, it descends with a rapidity which the eye can scarcely follow, through a space of 30°, and sinks into the bulb. Not doubting that it was frozen, I broke the instrument, and found the mercury in a solid state.

"The mercury may be frozen in a still more convenient manner, by putting a small quantity into a watch glass, adding the liquid sulphurous acid, and evaporating in the air-pump. We may thus freeze, in 4 or 5 minutes, 15 or 20 grammes of mercury, adding as much sulphurous acid. As the mercury is in this way constantly seen, we can easily note the instant of congelation, and we perceive its surface no longer of an uniform curvature, like a fluid, but having irregular depressions, occasioned by the process of crystallization.

"I have since attempted the congelation of *ether* and *alcohol*, by surrounding with cotton, small balls filled with these fluids, pouring on them sulphurous acid, and placing them under the receiver of an air-pump. *I have thus succeeded in freezing alcohol of a strength below* 33° (spec. grav. 0.8 at 55°); but I have not been able to freeze ether or absolute alcohol. This last, however, acquired a much more viscid consistency than it has in its ordinary state.

"I have not been able to measure with accuracy the different temperatures which I obtained, as these cannot be taken with ordinary instruments; but I expect to have soon at my disposal the means of doing this with precision.

"However great be the cold produced by the evaporation of the sulphurous acid, it still has its limits. When we evaporate it, indeed, in the air-pump, it produces at first much fluid, but at the end of a certain time the acid freezes, and the mass of cotton impregnated with it becomes hard and solid. In this state, its vapour has only a feeble tension, and the evaporation being greatly retarded, the cooling stops much more quickly, as in consequence of the great difference of temperature between the cold body and the surrounding medium, the equilibrium between them tends to re-establish itself very quickly.

"I have recently tried with success to apply the cold produced by the evaporation of sulphurous acid to the liquefaction of several other elastic fluids. In doing this, I made the gas, when well dried by the chloride of calcium, to pass into a tube, having at its horizontal branch a ball of thin glass, while the vertical branch is plunged in a vessel containing mercury. I surrounded with cotton the ball on the tube through which the gas passes; and I poured upon it some drops of the sulphurous acid, which I volatilized by a current of air, and at the end of a short time the gas condenses. I have thus succeeded in liquefying chlorine, cyanogen, and ammoniacal gas, under a pressure of some centimetres of mercury. These are the only gases which I have tried at present, but

I expect to be able, by this means, to liquefy many others, and perhaps all, by combining pressure with a reduction of temperature, particularly if we employ for this purpose bodies such as ammoniacal gas, liquefied cyanogen, &c. which, being much more volatile than the sulphurous acid, may produce a more considerable reduction of temperature.

"I require only a little leisure to make farther experiments, which may be worthy of being reported to the Society. I shall only remark, that in pouring cyanogen or liquid chlorine in water, an efflorescence takes place, as with the sulphurous acid, and a thick stratum of ice is formed on the surface."

III.—*Memoir on the Theory of Magnetism.* By M. Poisson.

This very elaborate and profound memoir, of which an abstract has been published in the *Annales de Chimie,* was read to the Academy of Sciences on the 2d February, 1824. The object of the author in this investigation, is generally to determine the results of the attractions and repulsions of the boreal and austral magnetic fluids, and the laws of their distribution in magnetised bodies. In the present memoir, its distinguished author confines himself to the theory of the distribution of magnetism in bodies, such as soft iron, that are magnetised by induction only, and without any coercive force; and in a second memoir, not yet completed, he proposes to apply the general theorems demonstrated in this memoir, to the distribution of magnetism in needles of steel magnetised to saturation, in which the distribution becomes permanent by the action of a coercive force.

The investigations of M. Poisson are founded on the ingenious theory of Coulomb, that the boreal and austral fluids, in place of being transferred, as was formerly supposed, to the opposite ends of the magnetised body, are only displaced in a very minute degree, and do not even quit the particles of the body to which they originally belonged before it was magnetised.

From an experiment of M. Gay Lussac's, (see page 373.) M. Poisson supposes, that the mutual action of two magnetic particles belonging to different bodies, depends on the matter of each of these bodies. The quantity of both fluids, in each substance, when neutral, is supposed to be without limit, and, therefore, the difference in the action of two different metals, under the same magnetic influence, cannot be ascribed to different quantities of boreal and austral fluids in each of them, but to a difference of action on their particles.

The physical foundation of the question being established, he proceeds to consider the disposition of the boreal and austral fluids in magnetised bodies. In a cylindrical needle of soft iron, small in diameter, and finite in length, its two fluids are united in equal quantities through its substance, and their actions being equal and opposite, they destroy each other, and exhibit no indication of magnetism. Let a centre of magnetic action, or a magnet, be placed in the direction of the axis of the cylindrical needle produced, the fluids will now be decomposed, or separated from each other, but each boreal and austral particle will be very little removed from its original position, and, in this state of displacement, the two fluids will succeed each other alternately along the length of the needle, and the length will consist of a series of very small parts, each of which will contain, as in the neutral state, the two fluids in equal quantities. M. Poisson does not think it necessary to inquire, whether the length of those parts is equal to that of the constituent molecules of the iron, but he assumes it to be very minute,[*] so as to have no perceptible relation to the diameter of the needle.

From the equations of magnetic equilibrium, M. Poisson deduces the general consequence, *that though the boreal and austral fluids are distributed throughout the mass of a body magnetised by induction, yet the attractions and repulsions which it exercises externally, are the same as if it were merely covered by a very thin stratum formed of the two fluids, in equal quantities, and such that their total action upon all the points within them should be equal to nothing.*

If the body contains an empty space within it, and if there are centres of magnetic force within that space, and without the body, the body must be regarded as terminated by two thin strata, corresponding to the interior and exterior surface; and the action of these two strata on any part of the substance, joined to that of all the given centres of magnetic action, must produce a perfect equilibrium. In this case, the boreal and austral fluids may exist in different quantities in each of these strata, provided they are always in equal quantities in the two surfaces taken together.

When the general formulæ are applied to the case of a hollow spherical shell of uniform thickness, the following remarkable theorem is obtained:

A magnetic needle placed in the interior of a hollow sphere of soft iron, and so small as not to exert any sensible influence on the sphere, will not be subject to any magnetic action, and will, consequently, not exhibit any polarity from the effect of the earth's magnetism, or from that of any other magnets placed without the hollow sphere.

Hence it follows also—

That if magnets are placed within this sphere, their action on a small needle without it, joined to that of the sphere itself, as magnetised by their action, will produce a result equal to zero. This is obvious, for, from the second part of the theorem, the exterior action must be the same as if the two fluids were united in the centre of the sphere, which would neutralise their action at all distances, as these fluids are necessarily present in equal quantities. Hence, if we consider a plane as a sphere of infinite radius, we may infer,

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[*] See the paper in this Number, page 212, on the pyro-electricity of the minutest particles of the tourmaline and other pyro-electric minerals.

That the interposition of soft iron, of any given thickness, but of a great extent, must be sufficient to prevent the transmission of the magnetic action.

In applying the formulæ to a hollow sphere magnetised by the earth's action, it follows,—

That though the magnetism is not confined to the exterior surface of the hollow sphere, and though its intensity may be determined for any point of the solid shell, yet the magnitude of the three component forces produced by it, (on a point without it,) IS WHOLLY INDEPENDENT OF THE THICKNESS OF THE METAL.

In comparing this theory with the ingenious experiments of Professor Barlow of Woolwich, the general agreement is so striking, as to leave no doubt either of the accuracy of the theory itself, or of most of the important deductions and laws which Mr. Barlow had previously obtained from direct experiment.

IV.—*Ueber die ungleiche Erregung der Wärme im prismatischen Sonnenbilde.*

On the Unequal Production of Heat in the Prismatic Spectrum. By M. SEEBECK. Read 13th March, 1819, and inserted in the Memoirs of the Royal Academy of Sciences of Berlin for 1818–1819, p. 305.

THE labours of several natural philosophers have been directed towards this curious subject. According to Landriani, the highest degree of temperature is produced in the yellow. Rochon finds the place between yellow and red the warmest, which he calls *orangé* and *jaune-orangé*. Sénebier states it as the result of many observations, that the red is always warmer than violet, but yellow sometimes warmer than red. Herschel found the warmest point beyond the coloured spectrum produced by the prism. Leslie could not discover any difference of temperature either above or below the spectrum, but found the warmest place in the red. Englefield soon afterwards arrived at the same results as Herschel, and maintained that the highest degree of temperature was always found beyond the outer limit of the red.

The discrepancy in the results of so many accurate observers led Mr. Seebeck to examine whether the apparatus or the mode of observation might not account for this difference in the results. The observations which form the substance of this paper were instituted in the course of the years 1806—1808. Mr. Seebeck soon abandoned the use of a quicksilver thermometer for that of an air thermometer, with a single ball, which he found far to surpass his expectations. The greatest difficulty in the employment of the instrument arose from its oscillations, produced by sudden changes in the atmosphere, clouds, however faint, or moist collecting before the sun, as very often happens even in apparently serene weather. The observations, therefore, were frequently repeated with the same prisms on different days, apparently most clear and devoid of damp, and they were found to correspond best with one another after a thunder storm, or during the first serene days after a continued rainy period.

Mr. Seebeck's apparatus consisted of a simple thermometer tube, 15 inches long, with a very thin ball, half an inch (Paris measure) in diameter. This ball was uniformly covered with Indian ink, and a scale fixed to the tube, whose 0 was one inch distant from the ball, the upper part being perfectly disengaged. The length of the coloured fluid in the tube, the latter having been sufficiently wetted, was about one inch. This thermometer was exposed to the light only with its ball, being fixed upon a support which allowed it to be raised or depressed, and applied either vertically or horizontally. A screen was made use of for keeping off the superfluous part of the spectrum, having a fissure, which could be widened or contracted at pleasure. Sometimes also experiments were made with only one half of the screen, or with no screen at all.

The room was exposed to the south, was large, and could be perfectly obscured. The time of the observations was between eleven and one o'clock. The prism was either fixed to the window shutter, or a ray of light of about 7 inches square let fall upon the prism, which was so disposed as to have the refracting angle lowermost, covering the upper third side with black paper; also sometimes the lower edge was covered, in order to obtain a better defined spectrum. Generally the prism was stationary in this position, the thermoscope being exposed to the differently coloured rays in different heights, in doing which due attention was paid to the difference of temperature arising from the distribution of the heat in the room, which was always colder below, being covered with a stratum of plaster.

The prisms employed were various in descriptions and size from $\frac{3}{4}$ to $1\frac{1}{4}$ inch broad, and many of them also, though not considerably, different in their angles from 60°. Experiments made with the greatest or smallest angle of the same prisms did not give any perceptible difference.

Mr. Seebeck proceeds now to enter into the detail of a great number of observations, from which he draws the following results:

1. There is always heat produced in the prismatic spectrum, which is least in the limits of the violet.

2. The heat increases through blue and green; and,

3. Reaches its maximum in yellow for certain kinds of prisms, particularly of water; and according to Mr. Wünsch, also of alcohol and oil of turpentine.

4. The solution of sal ammoniac, and of corrosive sublimate and concentrated colourless sulphuric acid produce the highest degree of temperature between the yellow and the red, in the orange.

5. Crown glass or common white glass has the warmest point in the middle of red.

6. Flint glass moves the warmest point beyond the well-defined spectrum. (Mr. Seebeck adopts here the limits as given by Newton.)

7. Beyond the red, the degrees of temperature diminish, but a slight action is perceptible in all the prisms.

Mr. Seebeck had found that the colour of muriate of silver produced by the action of the prismatic spectrum is different in proportion to these colours themselves, being reddish-brown in and beyond the violet, blue or bluish-gray in the blue, unchanged white or faintly tinged with yellow in the yellow, and red in and beyond the red. In the prisms of flint glass, which produce the highest degree of heat beyond the red, also this colouring was found entirely beyond the prismatic spectrum.

Mr. Seebeck observes, that the authors who have treated the same subject have not in general sufficiently, some of them even not at all, indicated what prisms they employed in their experiments. The depression and successive rise of temperature observed by some philosophers from the yellow towards the red seems to be produced by the application of lenses for collecting the rays of light. Mr. Seebeck never obtained a single result of that kind, as he always observed the action of the simple rays. He found that a prism of common glass, one side of which was rough, brought the maximum of temperature below the red, while the same prism having this side polished, gave the general result of the highest temperature in the red. Mr. Seebeck considers the halos of light on the extremities of the spectrum as appertaining to it. They had been observed by Newton, but considered by him and his successors, as being produced by irregularly distributed light. The halo below the red has a faint red colour, that above the violet is very pale violet blue. These colours insensibly diminish, so that no limits can be assigned to them, and they are easily observable if condensed by collecting lenses. There are also prisms which produce halos, very distinct and well defined, owing to the occasional texture. These should be excluded in making experiments on coloured light. But not only bad prisms, as Mr. Wünsch assumes, but even the best produce the above-mentioned faint halos. Ritter first remarked a faint yellow and red immediately below the blue in prisms of glass. Mr. Seebeck observed the same in a prism of water whose refracting angle was 40°.

In concluding his paper, Mr. Seebeck remarks, that, in judging of coloured light, it is always necessary to consider not only the intensity but also the colour, or as he calls it according to Göthe, the polaric opposition of colours, as distributed in the spectrum, in analogy to the properties exhibited by a magnetic bar. Upon the same principle, he found that orange-coloured glass depressed the place of the maximum of heat in a prism of crown glass, while blue glass, combined with a prism of flint glass, showed the same temperature in and beyond the red. These observations, however, Mr. Seebeck does not consider equally decisive with many of the other ones.

ART. XXV.—NOTICES OF RECENTLY PUBLISHED BOTANICAL WORKS.

GREAT BRITAIN.

We pledged ourselves in the previous Number of this Journal, to notice the *Periodical Botanical Works* which appear in Great Britain; and such is the increasing taste for this delightful study,—so successfully are the vegetable productions of foreign climes now cultivated in our gardens,—and so great is the number of living plants introduced to our collections, that no less than six monthly publications, containing coloured figures and descriptions of between forty and fifty exotic species, are circulated in Britain. Nor is there any reason to fear that there will soon be a want of subjects to meet this great demand. At no period, and most assuredly in no country but this, has the science of horticulture been so much followed as at the present time. The gardens of Oxford and Cambridge, once so celebrated, have indeed lost their names; but there exist the Royal Garden of Kew, with its incomparable collection of New Holland and Cape plants; the noble institution of the Horticultural Society at Chiswick, conducted upon a scale so extensive, and on a plan so liberal, that every botanist and every cultivator in Europe may share in its benefits; that of Liverpool, which is so peculiarly rich in East and West Indian plants; the extensive grounds of Messrs. Loddige's, whose palm-house stands unrivalled; and of Lee and Kennedy, Whitley and Brames, &c. which, under the name of nurseries, contain a vast assortment of new and rare plants, to which men of science have ready access; numerous private collections, especially in the vicinity of London, amongst which those of our esteemed friends, Mr. Barclay of Bury Hill, Mr. Cattley at East Barnet, and the late Mr. Walker, will hold the first rank; the new Royal Botanic Garden of Edinburgh, which is so munificently supported by government, so ably directed by Dr. Graham, and so well cultivated by Mr. M'Nab; and what we shall mention last, though it is not the least in our esteem, the Royal Botanic Garden of Glasgow, which, with all the advantages it possesses by the vast commerce of the city, and while it continues to be as zealously supported by its numerous and wealthy proprietors as it has hitherto been, will not shrink from a comparison with any of the establishments now mentioned. These, and far more than we can speak of specifically, have, aided by their treasures, the labours of the authors just alluded to, and not of themselves; for the works of Smith, of Brown, of Lindley, and of Salisbury, and Andrews, and Roscoe, bear testimony to the benefit that their respective authors have derived from them.

The publications which it is now peculiarly our intention to notice, are,

First, the "*Botanical Magazine,*" begun by Mr. Curtis, and continued by Dr. Sims, the oldest established work of all, having been commenced in 1786. Of this work, as is well known, the greater number of the figures were from the pencil of the accurate Mr. Sydenham Edwards; latterly they have been executed by Mr. J. T. Curtis, who possesses a talent for drawing plants, which is scarcely to be excelled but by his inimitable representations of insects; of which a lasting monument to his abilities will be found in the plates to Mr. Kirby's century of insects, in the volume of Linnean Transactions, and in his admirable work, entitled, "*British Entomology.*" The engravings are by Weddell.

Secondly, The "*Botanical Register,*" established in 1815, by Mr.

Kerr, but in which we find many articles from the able pen of Mr. Lindley. The drawings in the early part of this work are by Mr. Sydenham Edwards; Mr. Hart is the present draftsman; Mr. Watts is the engraver.

Thirdly, The "*Botanical Cabinet*," by Conrad Loddiges and Sons, a publication begun in 1818, which, though pretending to nothing more than giving such a representation of each plant as shall be recognised at first sight, together with some account of their qualities and modes of cultivation, yet contains (for it has now extended to nearly nine volumes) a great mass of figures, drawn in a very masterly style by one of Mr. Loddige's own family, and engraved by the eminent Mr. George Cooke. We believe, from the great success this little work has met with, that one favourite object with the worthy authors is accomplished, namely, the desire which they have that others should share in the gratification they have themselves so abundantly enjoyed in contemplating and studying these varied productions of the vegetable kingdom. If we may be permitted to find fault, where there is so much to praise, we should say that the absence of generic and specific characters and synonyms is a defect, the inconvenience of which we have often experienced. These would occupy a very small space, and could not but be generally acceptable.

Fourthly, Hooker's "*Exotic Flora*," commenced in 1822, with drawings by the author, which are engraved by an excellent artist of Glasgow, Mr. Swan. The principal design of this being to give figures of new plants, or of such rare and little known ones as are most deserving of illustration, either from the peculiarity of their characters, their history, or their properties, Dr. Hooker is very full on the dissections of the parts of fructification, both in his plates and descriptions; and we find in it a very considerable number of Orchideous plants, which are no less remarkable for the curious and varied structure of their flowers, than for their beauty of form and colour.

Fifthly, Mr. Watson began in 1822, his "*Dendrologia Britannica*," or History of the Trees and Shrubs which will live in the open air in Britain, which has extended to 19 Nos. The plates are accompanied by specific characters, arranged upon a new and peculiar plan, of which we do not exactly see the benefit. The observations and critical remarks, &c. are to appear afterwards.

Sixthly, and lastly, we shall mention Mr. Sweet's "*Flower Garden*."

The concluding one of these publications not being at this time within our reach, and Mr. Watson's work having professedly not one of the descriptions completed, we shall confine our attention to the first four of the publications just enumerated; beginning with that number of each which appeared at the same time with the first number of this Journal; and we shall continue thus to review them consecutively.

Botanical Magazine for July, No. 450.

Tab. 2495. *Sida aurita* of Wallich, of which no representation had previously appeared. Sent to the country from the East Indies by Dr.

Wallich. t. 2496, *Conanthera bifolia*, a plant of Chili, where its bulbous roots are eaten by the natives, both boiled and raw, and said to be very good in soup. t. 2497, *Laurus aggregata*, n. sp. "foliis perennantibus ovatis acuminatis triplinerviis subtus glaucis, pedunculis simplicibus axillaribus aggregatis, bracteis scariosis ovatis concavis." Introduced by the Horticultural Society from China. Allied to *Laurus Myrrha*. t. 2498, *Canna edulis* of Botanical Magazine. t. 775, a species from Peru, with tuberous esculent roots, and ascertained to be the *C. indica* of Ruiz and Pavon. Introduced by Mr. Lambert. t. 2499, *Aspidistra lucida* of Bot. Reg. t. 628; which Mr. Brown considers as having some affinity with Tupistra. t. 2500, *Wulfenia carinthiaca*. t. 2501, *Psidium Cattleianum*, of which so fine a figure is given by Mr. Lindley in his *Collectanea Botanica*. t. 2502, *Sarcophyllum carnosum* of Thunberg.

No. 451. *August*.

Tab. 2503, *Astrapæa Wallichii* of Lindley's *Collect. Bot.* t. 14, figured, as was the plate in the *Bot. Reg.* from a plant which blossomed in his Majesty's Collection at Kew. t. 2504, *Erinus lychnidea* of Willdenow, a native of the Cape of Good Hope. The pure white of the upper sides of the petals contrasts remarkably with the colour of the underside, which is a deep brown, having only a narrow white edge. The flowers we have observed to be delightfully fragrant; and Mr. Murray, the curator of the Glasgow Botanic Garden, finds that it bears the open air, and flourishes exceedingly during the summer months, as well as the equally fragrant *Schizopetalon Walkeri*. t. 2505, *Ixora barbata* of Roxburgh's *Flora Indica*; first sent to Britain by the late Mr. Potts, one of the collectors for the Horticultural Society, who died last year on his return from the East Indies. t. 2506, *Pedicularis canadensis*; brought over from North America by Mr. D. Douglas, another collector, who has just embarked in the service of the Horticultural Society, on a mission to the north-west coast of America, whence it is expected that he will return at the same time with Captain Franklin over land to Hudson's Bay. t. 2507, *Fuchsia decussata* of the *Flora Peruviana*, a splendid plant, to which it is perhaps hardly possible for the pencil to do justice; drawn from an individual, of which the seeds were sent to the Edinburgh Botanic Garden, from Chili, by Cruickshanks. Plants of it likewise exist in the garden of Glasgow, derived from the same source. The flower is about twice as large as that of *F. coccinea*, far more gracefully pendant and more brilliantly coloured. t. 2508, *Arum bulbiferum* of Roxburgh's *Flora Indica*, "acaulis, radice tuberosa, foliis decompositis bulbiferis, spatha cucullata, spadice cylindracea parum longiore." Native of Bengal, and introduced by Mr. Brooke of Ball's Pond, Islington.

Botanical Register, *No.* 113. *July*.

Tab. 809, *Amaryllis ignea*, a new species, "umbella 6. flora, perianthii laciniis in tubo cylindraceo convolutis, pedunculis perianthii nutantis longitudine, stylo exserto, stigmate simplicissimo." Mr. Lindley, after remarking that this plant is a congener of *A. cyrtanthoides* of Dr. Sims, justly observes, "that the old genus *Amaryllis* contains the rudiment of several genera, cannot be doubted; but the principles upon which they are to be separated remains to be ascertained; and in our judgment it is wiser to refer doubtful plants to an admitted genus provisionally, than upon uncertain principles to create a new one, which the next discovered species may render it necessary to remove." Observations these which, we think, equally applicable to the Orchideous plants, of which almost every new species that we receive appears, according to the nature of the present characters, adequate to constitute a new genus. *Amaryllis ignea* was sent to England from Chili by Lord Cochrane. t. 810, *Oxalis Plumieri* of Jacquin (*O. frutescens, Linn.*) brought from St. Vincent by Mr. M'Crae. t. 811, *Azalea Indica,* with a pure white flower. t. 812, *Cineraria speciosa,* which had been considered a variety of *C. sibirica,* and is a native of the same country with that species. t. 813, *Chlorophytum orchidastrum,* a genus belonging to the natural order *Asphodeleæ, Br.* first established in the *Botanical Magazine,* of which there are at present four species; two of them, of which the present is one, natives of Sierra Leone, of the Cape, and one of New Holland. This has a close affinity with *C. inornatum;* but is thus distinguished, "2-pedalis, foliis lanceolatis acuminatis a basi stricto-patentibus, panicula ramosa stricta multiflora, ramis glabris." t. 814, *Ornithogalum virens, n sp.* sent by the late Mr. Forbes from Delagoa Bay, in Southern Africa, to the garden of the Horticultural Society. "*O. virens,* racemo spicato multifloro, foliis lineari-lanceolatis debilibus ad apicem breviter teretibus acuminatis, sepalis patentibus, staminibus alternis bidentatis, bracteis floribus longioribus." t. 815, *Hedysarum adscendens,* (Willd.) *var. cæruleum,* a native of Brazil. t. 816, *Narcissus gracilis,* (Sabine's MSS.) "12-18, uncialis, foliis lineari-subulatis canaliculatis, scapo terete 1-2. floro, ovario inflato, flore sulphureo." It is here given, both as the opinion of Mr. Sabine and Mr. Lindley, that those individuals of *Narcissus,* which are usually considered species, are but varieties, capable of being so distinguished; and, farther, that in most instances Mr. Haworth's genera are the species, and such of the same ingenious writer's species as can be distinguished from each other, the varieties of *Narcissus.*

Loddiges' Botanical Cabinet for July, No. 87.

Tab. 861. *Piper maculosum.* 862. *Andromeda calyculata.* 863. *Epacris rosea.* 864. *Amaryllis calyptrata.* 865. *Rhipsalis Cassutha.* 866. *Atragene capensis.* 867. *Erica melanthera.* 868. *Asplenium palmatum.* 869. *Saxifraga oppositifolia.* 870. *Croton pictum.*

No. 88. *August.*

Tab. 871. *Soldanella montana.* 872. *S. Clusii.* 873. *Marica Northiana* 874. *Erica alopecuroides.* 875. *Trillium sessile.* 876. *Epacris purpurascens, rubra.* 877. *Bryophyllum calycinum.* 878. *Zieria lanceolata.* 879. *Hibbertia grossulariæfolia.* 880. *Grevillea sericea.*

Hooker's Exotic Flora for July. No. 12.

Tab. 110, *Paullinia Meliæfolia* of Jussieu, introduced to this country by Richard Harrison, Esq. of Argsburgh, near Liverpool, and communicated by Messrs. Shepherd. t. 111, *Ficus nitida*, from the West Indies; but although tolerably well agreeing with the figure referred to by our authors in the *Hortus malabaricus*, the true plant, yet it is probably a distinct species: from the Liverpool Garden. t. 112, *Epidendrum? polybulbon*, of Swartz, likewise from the Botanic Garden of Liverpool, having been introduced from Jamaica by C. Horsfall, Esq. of Everton. t. 113, *Iantha pallidiflora*, another graceful orchideous plant, which being unable to refer satisfactorily to any known genus, Dr. Hooker was induced to construct for it that of *Iantha*, from the general resemblance of its flowers to those of a violet. Mr. Lindley has, however, since informed us that it is of the same genus as the *Ionopsis pulchella* of Humboldt, Kunth's Nova Genera, &c. v. i. p. 348, t. 88, in which opinion he is most assuredly correct, so that the latter name must be preferred. Mr. Lindley has received what he considers to be the same species from Mexico, and he farther observes, that *Epidendrum calcaratum* of *Fl. Peruvinea*, and *Dendrobium utricularoides*, and *testiculatum* of Swartz, are other species of the same genus. The *Iantha pallidiflora* was received at the Botanic Garden of Glasgow from the Baron de Schack, M.D. Trinidad; and the same plant has subsequently been sent from Liverpool.

No. 13. August.

Tab. 114, *Polypodium plantagineum*, drawn from dried specimens sent by the Rev. Lansdown Guilding. t. 115, *Prescotia plantaginifolia*, belonging to a new genus of orchideous plants, evidently allied to *Malaxis*. The generic name was given by Mr. Lindley in honour of John Prescot, Esq. of St. Petersburgh, a gentleman known no less by his acquaintance with the more minute departments of botany, than by the facilities which he affords to communication between men of science in this country and Russia. The species is from Brazil, where it was gathered by Mr. Forbes, and sent to the Horticultural Society. We have dried specimens of the same, which have been communicated by Mr. Boog from Rio Janeiro. t. 116, *Cymbidium? bituberculatum*, a new species, "sub-bulbosum, foliis quaternis ovatis plicato-strictis undulatis, labello reflexo, basi tuberculato, corollæ laciniis duobus interioribus." t. 117, The beautiful *Aspidium nodosum*, remarkable for the joint in the stipes. Native of the West Indies, and communicated in a dry state from St. Vincents by the Rev. Lansdown Guilding. t. 118, *Primula Palinuri* of Jacquin.

Drummond's Musci Scotici.

Although we are always happy to notice the botanical works that may appear in any country, and shall have pleasure, whenever it lies in our power, in making known their merits, yet we confess that we feel peculiar satisfaction in doing justice to those that originate in Scotland;

and especially when they treat of the plants of that country. Mr. Drummond is the successor of the late Mr. Don, in the nursery at Forfar; and he seems to be inspired with the same zeal in botanical research as his well-known predecessor. Like him, too, he has devoted much attention to cryptogamic botany, particularly to the mosses, in which department Scotland is so rich; and having collected great numbers of rare, and some new species, he has been advised to publish specimens, neatly arranged in the form of a book, correctly named, and accompanied by a few synonymes, and the names of their places of growth. In size of paper, and general arrangement, this work is similar to that of Mougeot and Nestler in the *Plantæ Cryptogamicæ Vogeso-Rhenanæ*. Each volume is to consist of a hundred leaves, upon each of which is fastened an excellent specimen; and the name, synonymes, and habitat are given on a label below. The author has contented himself with referring to Hooker and Taylor's *Muscologia Britannica*, and the two Scottish works, Hooker's *Flora Scotica*, and Greville's *Flora Edinensis*. A list of the species is printed at the beginning, and the whole is entitled "*Musci Scotici*, or Dried Specimens of the Mosses that have been discovered in Scotland, with references to their localities, by Thomas Drummond of Forfar."

We may observe that the specimens are in excellent order, and well selected. Besides many of the mosses that are more frequently met with, we shall mention as among the rare kinds, No. 7. *Gymnostomum lapponicum*. No. 8. *G. curvirostrum*, the true one, different from the *G. rupestre*, with which it has, we believe, been confounded by many authors. No. 9. *G. Griffithianum*, from the mountains of Clova. No. 10. *G. microstomum*. No. 24. *Grimmia ovata*. No. 27. *Weissia nigrita*. No. 48. *Trichostomum ellipticum*. No. 53. *Didymodon inclinatum*. 57. *Orthotrichum rupincola*, first published as British in Greville's *Edinensis*. No. 60. *O. Drummondii*, so named in Hooker and Taylor's *Muscologia Britannica*, *ed.* 2. MS. a new and very distinct species, which, we believe, has often been passed by as a variety of *O. crispum*. No. 64. *Daltonia heteromalla*, not before noticed as Scottish. No. 69. *Bartramia arcuata*, but without fruit. No. 71. *Conostomum boreale*. No. 95. The beautiful *Hypnum Cristacastensis*, which is not common in the Clova range of mountains.

The subjects for the second volume of this work, which will appear in the course of a few weeks, are already arranged; and we may assert that it will contain a greater number of rarities even than the first; among them will be seen the true *Gymnostomum rupestre*, *G. viridissimum*, *G. Donianum*, and *G. tenue*, *Tetraphis Browniana*, *Splachnum tenue*, *Tortula revoluta* and *convoluta*, two species which have been very little understood: *Grimmia trichophylla* of Dr. Greville in Flora Edinensis; *Grimmia spiralis*, (Hooker), and *G. torquata*, (Hoppe), *Grimmia leucophæa*, Greville in Wernerian Transactions, *G. Doniana*, *G. unicolor*, (Hooker, nov. sp.) The beautiful *Weissia splachnoides*; *Dicranum polycarpum*, *D. subulatum*, *D. virens*, *D. strumiferum*, *Trichostomum patens*, β. *piliferum*, *Didymodon flexifolium*, and the true *D. glaucescens*, *Orthotrichum cupulatum*, *O. Ludwigii*, (Schwaegr.), new to Britain; *O. Hutchinsiæ, O. speciosum,* new to Britain; *O. rivulare, O. Lyellii, Neckera pumila, Fontinalis squamosa,* in fruit; *Hypnum molle, H. salebrosum, H. abietinum, H. scorpioides,* fruit. The true *Leskea polyanthos, Bryum dealbatum, B. carneum var. Wahlenbergii, B. Zierii,* and *B. roseum,* in fructification.

BOTANICAL INTELLIGENCE.

Flora Danica.

We are extremely happy to be able to contradict a report which has been circulated in this country, that the *Flora Danica* would terminate with the 30th Fasciculus, by an assurance from the learned author himself, who along with this 30th Fasciculus, sent us the information, that only two-thirds of it are completed, and that during the summer of this year he has been making excursions to collect new materials.

Lindley's Collectanea Botanica.

An eighth, and we regret to say, a last number of Lindley's valuable *Collectanea Botanica* may very shortly be expected.

Smith's English Flora.

We learn by a letter that we have just received from the eminent author of this work, that he is working with unabated ardour at the third volume of his English Flora. He will be able to give an English station, strictly so speaking, for the exceeding rare Woodsia hyperborea; some specimens having been kindly communicated to us very recently by our excellent friend, Mr. James Backhouse of York, which he discovered on the basaltic cliffs, below Caldron Snout in Middleton, Teesdale. He farther adds, that Mr. J. Hailstone has also found it on the top of Falconclint Scaur, in the same district.

Hooker's Flora Scotica.

This work, for a second edition of which the author is zealously collecting materials, is here brought to the notice of our readers principally for the purpose of soliciting from the botanists of this country notices respecting any new or rare species of plants they may discover, and thus be a means of rendering more perfect the Flora of this part of the British dominions. Already, the additions in the author's possession are very considerable, and whilst he is aided by the labours and the knowledge of such active and able investigators as Dr. Greville, Mr. Arnott, Captain Carmichael, and Mr. Drummond, they will still very materially increase. In a sketch like this, we should want room to enumerate all the new or interesting discoveries that have lately been made. It is hoped that Captain Carmichael may be induced to give his abundant discoveries, principally among the Algæ and the Fungi to the public in a separate form. Under the head of *Musci Scotici* of Mr. Drummond, we have mentioned some of his new discoveries, to which we may add a most important acquisition to the Muscologia of

Britain; the *Weissia latifolia*, which he has within these few days detected, in the Clova mountains, growing among the roots of the rare *Oxytropis campestris*; in the same situation as he found the almost equally interesting *Didymodon glaucescens*.

In Dr. Hooker's annual excursion to the Highlands with the students of his class, and accompanied by some scientific friends, this summer, there were several valuable additions made to the Scottish Flora, which are no less gratifying to the Professor, as evincing a spirit of zeal and knowledge in the students in the cause of botany, than interesting as concerns the geographical distribution of plants. *Hypnum trifarium* of Mohr, (a moss very distinct from *H. stramineum*, though united with it by Schwaegrichen) *H. alpestre* of Schwartz, and *Didymodon obscurum*, must now occupy a place in the British list, as natives of the Breadalbane mountains; and we are still more gratified in being able to add also the *Arenaria rubella*, only hitherto known as an inhabitant of Lapland, according to Wahlenberg, and of arctic America, where it was first discovered during Captain Parry's voyage. In a botanizing excursion, like that just alluded to, where a considerable number of individuals, animated by the same feeling, are alike eagerly engaged in the pursuit of the same objects, sharing alike in the pleasure and in the toil, it is perhaps scarcely fair to mention any one person as more immediately the discoverer of a plant than another. Yet we are sure that the fellow-students of Mr. Earl will have a pleasure in his being named as the first who fixed his attention upon the *Arenaria rubella*, on the highest point of Maelgreadha.[*] The graceful *Linnæa borealis* was also found to be an inhabitant of Finlarig Park by Killin, where the few flowers of it that were seen, diffused a most delightful odour.

Information concerning Botany in France.

The study of botany in France is advancing rapidly. M. Kunth, the friend and coadjutor of the great Humboldt, is still engaged in publishing the South American Collections. Aubert du Petit Thouars has given to the world a pamphlet upon his favourite subject, "The Formation of Trees," serving as it were for a continuation of his work, entitled, "Essai sur la Végétation, considérée dans la Reproduction, par bourgeons."

Auguste de St. Hilaire, who spent six years in exploring the interior of Brazil in search of plants, has commenced the publication of two important works on the vegetables of that fertile country: the one entitled "Plantes usuelles des Braziliens," of which two numbers have appeared; the other "Histoire des Plantes les plus remarquables du Brésil, et du Paraguay," of which four numbers are announced as ready for publication. We know no author more capable of doing justice to such a subject; and we shall not fail to notice the contents of the respective parts of these works.

M. La Billardière, so advantageously known by his publication on the plants of New Holland, which were gathered during the voyage in search of La Peyrouse, is engaged in preparing for the press an account of his plants collected in New Caledonia; and M. Gaudichaud those of the Sandwich Islands, which form part of the herbarium formed during the voyage of Captain Freycinet. These two collections comprise a great number of new and highly interesting species.

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[*] A hill which rises just above Killin, at the head of Loch Tay.

In the French papers of last year, we had accounts of M. Bonpland's continuing to explore the district of Paraguay in search of its natural productions. But it appears, as indeed we have all along understood from English travellers, that he is still a prisoner. In the Moniteur for June 1824, the following interesting article respecting him is inserted, extracted from a private letter from Rio Janeiro:—"During my stay in this country, I have procured some detailed information upon recent events in Paraguay, which country is still under the command of Dr. Franzia. The following is the most certain news that I was able to collect concerning the fate of M. Bonpland, which has excited so lively an interest in France and England, and indeed wherever the name of this intelligent and courageous traveller is known. It is about two years and a half since M. Bonpland was at Santa-Anna, upon the eastern shore of the Rio-Parana. There he had established some plantations of Paraguay tea. He was seized at noonday by a company of 800 men, belonging to the troops of Dr. Franzia. They destroyed his plantations, which were in a most flourishing state; they took forcible possession of the persons of M. Bonpland and of some Indian families, whom the urbanity of his manners, and the advantages of rising cultivation had attracted around him. Some of the Indians saved themselves by swimming, others who offered resistance were massacred by the troop. M. Bonpland, carrying on his shoulders a part of his valuable collections of natural history productions, was taken to Assumption, the capital of Paraguay, and thence sent to a fort in quality of physician to the garrison: the period during which he remained in that exile is unknown, but it is asserted that he has been since recalled by Dr. Franzia, the supreme director of Paraguay, and sent in another direction to inspect a commercial communication between Paraguay and Peru, perhaps near the province of Chiquitos and of Santa Cruz de la Sierra. M. Bonpland may there finish the labours of a long journey while he devotes himself to botanical researches. The friends of M. Bonpland flatter themselves with the hope that the steps taken for his liberation by the French government, by the Institute, and by M. de Humboldt, will not prove unsuccessful. General Bolivar has also written to the supreme director of Paraguay a letter, in which he lays claim to M. Bonpland as the friend of his youth, couched in the most affectionate terms. If M. Bonpland has the good fortune ever to return to his native country, he will be able to give much intelligence respecting districts hitherto wholly unknown."

ART. XXVI.—PROCEEDINGS OF SOCIETIES.

Proceedings of the Royal Society of Edinburgh.

June 6th.—There was read at this meeting a paper "On the Natural History and Physical Geography of the districts of the Himalayah Mountains between the river beds of the Jumna and Sutluj." By GEORGE GOVAN, M.D.

This paper, which was illustrated by a map of the country, containing the routes of the author, will appear in the next Number of this Journal.

At the same meeting there was communicated to the Society, by the Rev. Dr. FLEMING of Flisk, a paper by the Rev. JOHN MACVICAR, Dundee, entitled, "Observations on the Germination of Ferns."

The Society adjourned its meetings till November.

ART. XXVII.—SCIENTIFIC INTELLIGENCE.

I. NATURAL PHILOSOPHY.

ASTRONOMY.

1. *Observations on the Eclipse of the 26th January 1823, at Casan.*—M. Simonoff made the following observations on the eclipse at Casan in Russia:

Total immersion in the shadow, - -	7 h.	38′	56″.6	true time.
Emersion, - - - -	9	17	2,5	
End of the eclipse, - - -	10	14	58.8	

2. *Amici's Improvement on Astronomical Instruments.*—Baron Zach announces that Professor Amici has communicated to him a new principle, upon which he can construct instruments for taking heights, even to *thirds*, if the power of the telescope is sufficient. The method is independent of all minute subdivisions of the limb, verniers, or wire micrometers. All the measures are taken in the field of the telescope itself, upon an optical principle. We hope to be soon able to give an account of this valuable contrivance.

3. *Long absence of the solar spots.*—M. Flauguergues observes, in a letter to Baron Zach, dated 10th October 1823, that he has not seen any spots on the sun for the preceding sixteen months. He adds, that the heat of the summer does not seem to have been augmented by this cause.

4. *Eclipse of the Moon of July 10th observed at Bushey Heath.*—Colonel Beaufoy observed this eclipse at Bushey Heath, in west longitude 1′ 20″ 93 in time, and north latitude 51° 37′ 44″ 3.

July 10th Eclipse began { 15^h 29′ 18″ mean time at Bushey.
15 30 39 ——— Greenwich.

5. *Effect of Heat upon the Sextant.*—M. Rüppell, while making observations at Dongola, in Nubia, found that the excessive heats affected his sextant in a remarkable manner. The error of collimation changed every instant. The vernier, which embraced 10′ of the limb now occupied 10′ 15″. When he took the lunar distances, he often found sudden changes of 30″ 40″ or 50″, and often of a whole minute. These changes were attributed by M. Rüppell to a sudden expansion in the limb of the instrument, the divisions having been made on silver.—See Zach's *Corr. Astron.* Vol. ix. No. 1. p. 37.

6. *Singular spot on the Sun.*—On the 20th December 1828, M. Pons of Marseilles observed several small spots on the sun, forming a mass of spots. On the 23d, this mass was elongated so as to form only a single black spot, so near to the sun's limb that it could be seen on the day following. At the side of this black spot there was another more extended, with several branches, *but it was not black,* and might have been taken for a small cloud which passed over the sun's disc. I have never, adds M. Pons, either seen such a spot, or heard any person speak of it.—Zach's *Corr. Astron.* ix. p. 603.

7. *Observatory at Buenos Ayres.*—It appears from a Journal called the *Abeja Argentina* for August 1822, that an observatory was erected at Buenos Ayres, the capital of the republic. The latitude of the *Plate Vittoria* is stated at 34° 35′ 45″, and the longitude at 3^h 54′ 22 west of Greenwich, as deduced from the eclipse of the moon of the 2d August 1822. The same Journal informs us, that a Society of the Mathematical and Physical Sciences is established in the same city.—Zach's. *Corr. Astron.* Vol. x. p. 101.

8. *New Comet of 1821, observed only at Buenos Ayres.*—In the Journal above mentioned, under the head of *Astronomia,* are given the following observations on a comet which is said to have escaped the notice of all European astronomers! The observations are as follows:

	Geoc. Long.	Geoc. Lat. S.
1821, April 5^d 6^h 45′	26° 19′ 14″	21° 4′ 0″
15 6 45	39 57 20	22 24 10
25 6 45	46 46 10	23 19 30

The following elements are said to have been computed according to the method of Dr. Olbers:

Passage of the perihelion, 1821, March 23^d 1^h 57′ M. T.	
Long. of perihelion, - - -	11^s 15° 51′ 0″
Perihelion distance, - - - -	0.186
Long. of asc. node, - - -	0^s 14° 1′ 25″
Inclination of orbit, - - -	61 38 42
Motion, - - - - - - -	Direct.

We copy the above notice from a long letter on the subject given by Baron Zach (X. p. 104.) without expressing any opinion on so extraordinary a circumstance. It is strange that the *three* observations should have been made at the same hour and minute, and at exact intervals of ten days.

9. *Astronomical and Trigonometrical Surveys in Russia.*—The liberal and enlightened patronage which the Emperor Alexander has extended to science in general, and to useful knowledge of every kind, is nowhere more conspicuous than in the numerous astronomical and trigonometrical surveys which he has ordered throughout his extensive dominions.

Prince Wolkonsky, since he received the direction of the Etat Major of Russia, has placed all the surveys upon a fixed and excellent system. The survey of the government of Wilna, under the direction of Major-General de Tenner, has been carried on by the methods used in France for the measurement of an arc of the meridian, and the trigonometrical part has been for some time completed. General Tenner measured with Delambre's apparatus two bases, one near Driswiat, on the ice, and the other near Ponedeli, each of which was nearly 80,000 English feet long.

Nearly the third part of the government of Wilna is surveyed topographically, on a scale of $\frac{1}{21000}$; and in five years the whole will be completed. The astronomical observations were made by M. Wisniefsky, who has been employed for several years in determining the positions of many points in Russia. Major-General de Schubert has been carrying on, since 1820, the survey of the government of Petersburg. He has finished the triangles from Narva to the Ladoga, and has continued them as far north as the frontiers of Finland. He has measured a base of 33338,86 English feet at Slavancka, near Zarskoe-Selo. The scale of this survey is to be $\frac{1}{16800}$. The English foot is adopted in these surveys, the English inch being equal to 200 sagenes, or saschenes.

M. Struve proposes to connect his triangulations for an arc of the meridian with those of General Tenner at Dunabourg; and General Schubert expects to connect his with them at Hochland.—See Zach's *Corr. Astron.* ix. p. 171.

10. *Dr. Tiark's Astronomical Expedition.*—This expedition is, we understand, employed by the Board of Longitude to sail to Heligoland, Edinburgh, and the Nase of Norway, to settle the longitude of these points, and connect our reckonings with those of the Continent.

OPTICS.

11. *On a singular Scintillation of the Stars.*—On Sunday the 12th Oct. 1823, at 4h. A. M. Baron Zach (*Corr. Astron.* vol. ix. p. 301.) observed at Genoa a very remarkable scintillation of the stars, which astonished all who saw it. The stars seemed to throw out sparks and jets of flame with surprising rapidity and vivacity. The same effects were seen by every person, and also through an achromatic opera-glass, so that the phenomenon must have had its origin in the atmosphere, and was, we

think, owing to a want of homogeneity in the aerial medium, similar to what takes place in mixing alcohol and water.

Baron Zach observed another very curious fact, which surprised him more than the preceding phenomenon. When the observer fixed his eye steadily upon any star, its scintillations became more settled and tranquil; but the stars seen at the corner of the eye, or by indirect vision, became more disorderly and rapid in their scintillations. Baron Zach states, that he has sought in vain all our works on optics for an explanation of this effect.

The laws of indirect vision upon which this curious fact depends, have been investigated and explained by Dr. Brewster in a paper on the Eye, read before the Royal Society of Edinburgh on the 3d Dec. 1822. In that paper he has shown, that bodies seen by indirect vision alternately vanish and reappear even when seen with both eyes, and that they assume colours different from their natural ones, certain colours vanishing in preference to others.

12. *Direction of the Axes of Double Refraction.*—M. Fresnel informs us, in the *Bull. Philom.* 1824, p. 40, that M. Mitscherlich has found that in some salts, such as *Sulphate of Magnesia,* the one resultant axis is more inclined than the other to the faces of cleavage, or crystallized without any appearance of a defect of symmetry in the crystalline forms.

The same fact has been observed in the *Brazil Topaz,* and described by Dr. Brewster in the *Cambridge Transactions,* vol. ii. p. 5; but he attributes it to peculiarities of crystallization.

13. *On the Phosphorescence of several Sub-resins.*—M. Bonastre, who has made some interesting experiments on this subject, has given the name of sub-resins to those which are entirely deprived of essential oil; which are deprived of acid; and which are soluble only in boiling alcohol, ether, or the volatile oils. The property of phosphorescence, when they were pounded in a porcelain mortar with a glass pestle, he found in gum Elemi, gum Alouchi and the gum Arbol-a-brea from Manilla. In gum Elemi the light was pale and feeble, and less than is shown in pounding sugar. In gum Alouchi, well dried and heated, the light was much more vivid, and the colour a little reddish. It gave out slight scintillations. The gum Arbol-a-brea was more luminous than sugar, and even emitted light by friction in water. When these three gums were treated with Dilute Sulphuric Acid, they were phosphorescent in the same degree.—See the *Journal de Pharmacie,* Avril 1824, p. 193.

MAGNETISM.

14. *Gay Lussac on the mutual action of two magnetic Particles in different Bodies.*—This very interesting experiment was undertaken by M. Gay Lussac at the request of M. Poisson, (see p. 356.) for the purpose of ascertaining whether or not the mutual action of two magnetic particles depended on the matter of each of the bodies; which was found to be the case.

A magnetical needle, eight inches long, was found to make ten horizontal vibrations near the direction of the magnetic meridian in 131 seconds. A prismatic bar of soft iron, about eight inches long, $\frac{3}{4}$ths of an inch wide, and $\frac{1}{18}$th thick, in a vertical direction, was now fixed at the distance of two inches below the needle, and in the plane of the magnetic meridian. The oscillations of the needle became more frequent, being about 10 in 65 seconds, and soon after 10 in 60 seconds.

A similar and equal bar of pure nickel was now substituted in place of the iron bar, and the needle made at first 10 oscillations in 78 seconds, and soon after 10 in 77 seconds. When the bar of nickel was removed, the needle made 10 oscillations in 130 seconds by the action of the earth alone.—M. Poisson's *Memoir on Magnetism.*

ELECTRICITY.

15. *Berzelius's Method of distinguishing Positive and Negative Electricity.*—When the electric current passes by means of a point to the tongue, the *positive* electricity is *acid*, and the *negative* electricity a more caustic acid, or as it were *alkaline.*

16. *Production of electricity in freezing water.*—M. Grotthus has found, that when water is frozen rapidly in a Leyden jar, the outside coating not being insulated, receives a weak electrical charge, the *inside* being positive, and the *outside* negative. When the ice is rapidly thawed, the *inside is negative,* and the *outside positive.*

METEOROLOGY.

17. *Simonoff on the diurnal variation of the Barometer.*—From 4316 observations on the barometer, made in the Great Pacific Ocean, and at Taiti, M. Simonoff concluded that the lowest height of the mercury took place at 3h. 24′ P. M. and 3h. 18′ A. M. and the greatest height at 9h. 24′ A. M. and 9h. 30′ P. M. M. Simonoff accompanied Admiral Bellinghausen in the Russian expedition to the South Polar Regions.

18. *Comparison of Spirit of Wine and Mercurial Thermometers.*—A set of very important observations on this subject have been recently made by M. Flauguergues of Viviers, with peculiar care and attention. The spirit of wine thermometer was one made under the eye of Reaumur himself, by his pupil the Abbé Nollet, and the mercurial ones were octogesimal, and made by the best modern artists. The experiments were often repeated.

Temperatures.	Reaumur. Spirit of Wine.	Octogesimal. Mercury.
Mixture of *two* parts of pounded ice, and *one* part by weight of muriate of soda, - -	— 17°.4	— 16°.6
Mixture of two parts of pounded ice, and one part of muriate of ammonia, - - -	— 12.7	— 12.4
Mixture of two parts of pounded ice, and one part of crystallized sugar, - - -	— 5.0	— 4.9
Two parts pounded ice, and one nitre, - -	— 3.5	— 3.42
Melting ice, - - - - -	0.0	0.0

Temperatures.	Reaumur. Spirit of Wine.	Octogesimal. Mercury.
Well, 34 feet deep. Mean of six years' observation,	+ 10.47	+ 9.64
Cellar, - - - - - -	13.8	12.7
Human heat, - - - - -	32.7	29.8
Fusion and coagulation of yellow wax, -	56.½	49.6
Boiling alcohol, of the density 0.851; the barometer at 28 inches Fahrenheit, - -	75.6	63.5
Boiling mixture of three parts of the above alcohol, and one part of rain water, for the liquor used for Reaumur's thermometer; the barometer at 28 inches,	80.0	66.8

See Zach's *Corresp. Astron.* Vol. ix. No. 5. p. 435.

II. CHEMISTRY.

19. *Minerals produced by Heat.*—It has been very often observed, that the analyses of minerals are of comparatively little value, as long as we are not capable of reproducing by composition what had been dissolved. Professor Mitscherlich has accomplished this important object. We have been gratified by the sight of beautiful and well-defined crystals of grayish-white pyroxène, which had been obtained by mixing the constituent parts indicated by analysis in the necessary proportion, and exposing this mixture to the high degree of heat of the porcelain furnaces of Sèvres. By this means, Professor Mitscherlich has succeeded in obtaining several species that occur in nature. He has likewise observed among the different kinds of slags more than forty species in a crystallized state, particularly of such minerals as are found in primitive rocks, but likewise a good many others which have not hitherto been observed. We propose giving in our next number a full statement of the farther details of these most important experiments.

20. *Analysis of Copper green from Somerville, New-Jersey, by Mr. Bowen.*

Peroxide of copper .	45.175
Silica . .	37.250
Water . .	17.000
	99.425

21. *Berzelius's Analysis of the Sulphato-tri-carbonate of Lead.*—This eminent chemist, in analysing some specimens of this interesting mineral, sent to him for this purpose by Dr. Brewster, obtained the following results:

Carbonate of lead .	71.1
Sulphate of lead . .	30.0
Trace of muriatic acid .	
Trace of lime . .	
	101.1

In the letter with which M. Berzelius has favoured us on this subject, he remarks, that his result accords with that of Mr. Irving of Edinburgh, who found the carbonate of lead to be 73, and the sulphate 29, giving an excess of 2.0. (*Edin. Phil. Journal,* vol. vi. p. 388.) He likewise remarks, that as he had an excess of 1.1 of weight of the stone, it is probable that a part of the oxide of lead in it is in the form of a subsalt. "The result," he adds, "as it is, does not agree with the definite proportions; and the small quantity of the mineral did not permit me to make ulterior experiments."

Mr. Brooke, in his analysis, makes the results agree perfectly with the definite proportions, (*Edin. Journ.* iii. 118.) viz. about 72.5 of carbonate, and 27.5 of sulphate of lead. He had no excess of weight, and did not observe either the trace of muriatic acid or of lime.

22. *Ammonia disengaged from Plants during Vegetation.*—M. Chevallier has determined the very curious fact, that the Chenopodium vulvaria spontaneously disengages ammonia in a very free state during the act of vegetation; and he has also found, in conjunction with M. Boullay, that a great number of flowers, even among those which have a very agreeable odour, spontaneously disengage ammonia during vegetation. M. Chevallier likewise obtained ammonia from the Chenopodium vulvaria by distillation. (See the *Journal de Pharmacie*, Feb. 1824, p. 100.)

23. *Influence of Prussic Acid upon Vegetation.*—M. C. J. Th. Becker, in his *Dissertatio de Acidi Hydrocyanici vi perniciosa in Plantas*, which appeared at Jena in 1823, in 4to. has performed a number of experiments, from which it follows that the Prussic acid, prepared according to Vauquelin's method, destroys vegetable life in nearly the same manner as it acts upon animals. Grains immersed in this acid die, or lose their germinating faculty. The more delicate vegetables yield to it more readily than the robust ones.

24. *Benzoic Acid in the Oil of Dahlia.*—M. Payen having obtained an essential oil from the Dahlia, has determined, by numerous experiments, that it contains two substances, and that the crystallizable matter presents several of the characters of Benzoic acid.

25. *Cyanuret of Iodine.*—M. Serullas has discovered this new compound, which consists of azote, carbon and iodine. It is obtained by heating an intimate mixture of two parts of cyanuret of mercury, and one part of iodine, when both are quite dry. It has a strong and penetrating odour. Its taste is caustic. It neither alters paper of tournesol nor that of curcuma. When thrown upon a burning coal, it exhales abundantly violet vapours. M. Serullas considers it as composed of iodine 82.8, and cyanogen 17.2.—*Journ. de Pharm.* Mai, 1824, p. 257.

26. *Composition of Fulminic Acid.*—M. Liebig has found that the fulminating silver of Howard owes its detonating property to an acid capable of combining in different proportions with different bases, and of thus forming as many detonating salts. MM. Gay Lussac and Liebig having examined this *fulminic acid*, have found that this substance which cannot be obtained in an insulated state, is composed of one atom of cyanogen, and one atom of oxygen, forming probably together the

cyanic acid. Hence the neutral fulminates will be cyanates, and the different fulminic acids *bi-cyanates.* *Id.* p. 257.

27. *Sulphuric and Hydrochloric Acids found in the Rio Vinagro.*—M. Humboldt has recently communicated to the Academy of Sciences, that MM. Boussingaut and Rivero, who are exploring the Cordilleras of New Grenada, have analysed the waters of a river called Rio Vinagro, and have found in them, in a free state, the sulphuric and hydrochloric acids. *Id.*

28. *Dr. Henry's Method of Testing the Nitrous Oxide.*—Let a given volume of nitrous oxide be exploded with a slight excess of carbonic oxide of known purity, *e. g.* 110 or 115 measures of the latter to 100 of the former. Now, as each volume of real nitrous oxide gives, under these circumstances, an equal volume of carbonic acid, we may impute whatever carbonic acid is deficient of that proportion, to the mixture of so much nitrogen with the nitrous oxide. If using, *e. g.* an excess of carbonic oxide, there results from 100 measures of nitrous oxide only 95 of carbonic acid, we may safely consider the nitrous oxide to be contaminated with 5 per cent of nitrogen gas. Any nitrous gas may be previously separated by a solution of green sulphate of iron. *Manchester Memoirs,* vol. iv. New Series.

29. *Inflammation of Sulphuretted Hydrogen by Nitric Acid.*—M. Berzelius has announced that if a few drops of fuming nitric acid (nitrous?) are put into a flask with four or five cubical inches of sulphuretted hydrogen, and the flask closed with the finger, it becomes so warm as to produce combustion, with a beautiful flame, and a slight detonation, which forces the finger from the mouth of the flask. This experiment was made with *nitrous* acid more than twelve years ago, by our eminent countryman Dr. Hope.

III. NATURAL HISTORY.

MINERALOGY.

30. *Sillimanite, a new mineral species.* *Form* hemi-prismatic. It occurs crystallized in four-sided prisms of about 106° 30′ and 73° 30′; the inclination of the base upon the axis being 113°. *Cleavage* parallel to the longer diagonal of the prism. *Cross fracture* uneven and splintery. *Surface* of the crystals often rounded; the crystals themselves frequently bent.

Colour dark gray, passing into clove-brown. *Lustre,* brilliant upon the single face of cleavage. *Translucent* on the edges.

Hardness superior to that of quartz, or even of topaz. *Brittle,* and easily reduced to powder. *Specific gravity* = 3.410. Electricity or magnetism none.

The Sillimanite is infusible before the blow-pipe, alone and with borax, and not acted upon by acids. It consists of—

Alumine,	54.111
Silica,	42.666
Oxide of iron,	1.999
Water,	0.510
	99.286

Mr. George T. Bowen of Philadelphia analyzed this substance, and named it in honour of Professor Silliman of Yale College. It had been discovered in 1817, in the town of Saybrook, Connecticut, but considered as a variety of anthopyllite, to which it is said to bear a strong resemblance.—*Journal of the Academy of Natural Sciences of Philadelphia,* vol. iii. p. 375.

31. *Baryto-Calcite, a new mineral species.*—Form hemiprismatic. Figs. 19 and 20, Plate IX. represent two of the simplest and most common varieties.

Inclination of M upon M' = 106° 54′ *Brooke.*

h upon P (edge δ) = 106° 8′ *Brooke.*

$$b \text{ upon } b \begin{Bmatrix} \text{edge } \alpha \\ \text{edge } \beta \end{Bmatrix} = \begin{matrix} 95^\circ\ 15' \\ 84^\circ\ 45' \end{matrix}$$

h upon edge β = 119°

e upon edge β = 135°

Cleavage is perfect, and easily obtained parallel to the faces marked M, also perfect, though not so easily obtained parallel to P. *Fracture* uneven, scarcely perceptible. *Surface* of h striated parallel to the edges of combination with M, of which it intercepts the edge γ; the faces b, b, &c. and the numerous faces appearing in the place of the edge α are striated parallel to their common intersections.

Colour white, passing into dirty yellowish, greenish, and grayish tinges. The powder sometimes possesses a pale reddish tinge, according to Mr. Children. *Lustre* between vitreous and resinous. Transparent or translucent.

Hardness = 4.0 (equal to that of fluor spar.) *Specific gravity* = 3.66 *Children.*

The species of baryto-calcite was first established and described by Mr. Brooke, (*Annals of Philosophy,* XLIV. Aug. 1824, p. 114.) from specimens Mr. Broughton had left with him, and which he considered as something new. Mr. Brooke showed a specimen of it to Mr. Haidinger when in London, and on passing shortly afterwards through Alston, Mr. Allan and Mr. Haidinger obtained several specimens of this substance, to which part of the above description refers. Some of the crystals in Mr. Allan's possession are of considerable dimensions, being upwards of an inch and a half in length; but these exhibit that peculiar mode of decomposition by which they are gradually converted into a mealy mass of probably heavy spar. The beginning of this process is that coating which has been mentioned by Mr. Brooke.

This substance has been subjected to chemical examination by Mr. Children. It effervesces considerably with acids. Before the blowpipe, in the forceps, the surface becomes green; and the part of the flame beyond the assay also assumes a slight yellowish-green tinge. With borax in the oxydating flame, it gives a diaphanous globule, of a light amethystine colour, which becomes colourless in the reducing flame. It consists of

Carbonate of barytes, - -	65.9
Carbonate of lime, - -	33.6
	99.5

being one atom of each; from which composition the chemical name of the substance has been derived. The analysis, besides, gives traces of iron and manganese.

The only habitat of this mineral is Alston Moor, in Cumberland. The mineral evidently must be referred to the genus Hal-baryte of Mohs, with the rest of the species of which it possesses a strong resemblance.

32. *A new ore of Lead.*—*Form* prismatic, easily cleavable in two directions, meeting at an angle of 102°—103°, of a pale straw-yellow colour. This is the description given by Berzelius of a mineral which he discovered in the collection of the Royal Academy of Sciences of Stockholm, having the ticket—Lead-spar from Mendip, near Churchill, in Somersetshire. The specimen contained also carbonate and molybdate of lead. Before the blowpipe, it decrepitates slightly, and is easily melted; after cooling, the globule is of a deeper yellow colour than the mineral. On charcoal, it is reduced, and emits fumes of muriatic acid. With peroxide of copper and salt of phosphorus, the intense blue colour of the flame so characteristic of muriatic acid is produced. It consists of

Oxide of lead, - - -	90.13
Muriatic acid, - - -	6.84
Carbonic acid, - - -	1.03
Water, - - - -	0.54
Silica, - - - -	1.46
	100.00

The proportion supposed to represent the true chemical composition of the mineral is two atoms of oxide, and one atom of chloride of lead, in the ratio of 38.28 to 61.72. Berzelius observes, that the composition of the hornlead of Klaproth and Chenevix, whose form is a rectangular prism, is expressed by one atom of each of the two bodies, while the ordinary artificial submuriate consists of one atom of chloride and three atoms of oxide of lead.—See *Annals of Philosophy*, xliv. Aug. 1824, p. 154.

The same substance was noticed by Mr. Haidinger, when passing through Cornwall last summer with Mr. Allan, and considered as new. He has been indebted to Mr. Williams of Scorrier, and to Mr. Rashleigh of Menabilly, for specimens of it for examination. These specimens presented the following characters: *Form* prismatic. *Cleavage* highly perfect, and easily obtained, parallel to a four-sided prism of 102° 27′, and traces in the direction of its shorter diagonal. Traces of cleavage inclined to the axis of that prism, apparently in the direction of a horizontal prism, whose axis is parallel to the long diagonal of the transverse section of the vertical prism. *Fracture* imperfect conchoidal, uneven.

Colour yellowish-white, passing into straw-yellow, and a pale but distinct rose-red. *Lustre* adamantine, particularly upon the cross fracture of the prisms, inclining to pearly upon the faces of cleavage. *Translucent*. Hardness = 2.5.3.0 (between rock-salt and calcareous spar, nearer the latter). Rather brittle. Specific gravity = 7.077.

The varieties are massive, consisting of columnar particles of composition, of considerable size, which present a radiated fracture. They seem to have been engaged on all sides in a black soiling substance, which consists chiefly of alternating layers of hematitic and earthy black manganese, containing calcareous spar. The locality mentioned upon a ticket in the Menabilly collection was Mendip. The mineral in question resembles sulphate of lead (the prismatic lead-baryte of Mohs) in a remarkable degree, and must enter that same genus of his order Baryte.

33. *Localities of rare Minerals.*—Chrome-ore, the chromate of iron has been discovered by Sir Humphry Davy in small granular masses, disseminated in a greenish-white marble from Buchanan, in Stirlingshire, preserved in Mr. Allan's cabinet. Of the Cronstedtite of Steinmann, a mineral hitherto confined to Przibram, the same collection contains specimens from Wheal Maudlin, in Cornwall. The Cronstedtite from the latter locality, presents generally thinner individuals than the Bohemian one, but is, like this, accompanied by sparry iron, and hexahedral iron-pyrites. Another product of Wheal Maudlin has lately attracted the attention of mineralogists. The collections of Mr. Allan, Mr. Rashleigh of Menabilly, and Mr. Williams of Scorrier, contain pseudomorphous crystals of Wolfram, in the shape of tungstate of lime. They present the form, well known in that species, of an isosceles four-sided pyramid, bevelled on the solid angles contiguous to the base, sometimes of the size of three or four lines in every direction. They are generally engaged in blende, which is cleavable in large laminæ, and are composed in the interior of a delicate tissue of minute crystals, between which numerous cavities are conspicuous, lined with these crystals. Sometimes, also, the large pseudomorphous crystals are quite disengaged, and accompanied by arsenical pyrites, chlorite, quartz, &c. The colour of the streak is almost of the same colour in the pseudomorphous crystals, and the blende in which they are imbedded.

34. *English Locality of Metallic Lead.*—This substance has lately been found in situ in the neighbourhood of Alston. It occurs in small globular masses, imbedded in galena and a slaggy substance, accompanied with red litharge, crystals of blende and quartz. The vein in which it is found is in limestone, and of the thickness of an inch, widening out to two or three as it goes down. The whole mass within the vein is considerably decomposed, and the ore is found in incoherent pieces, some of which are about the size of a walnut. Many of them have a very slaggy appearance, both externally and internally, while others are pure galena, distinctly cleavable, and coated with a white mealy sulphate of lead, produced by decomposition. A more particular notice of this mineral will probably soon be given.

35. *American Localities.*—Petalite has been discovered by Dr. Troost in specimens from the north shore of the lake Ontario, on the beach in front of York, the capital of Upper Canada, in a rolled mass weighing about a ton, associated with boulders of greenstone, syenite, Labradore-feldspar, &c. The specific gravity of this new variety 2.593, so far surpasses that of the Swedish petalite, that the identity of the two minerals, if this statement be exact, is rendered very doubtful.

Spodumene has been found by Mr. Nuttall in Sterling, Massachusetts. Mr. George Bowen discovered it among specimens from Deerfield, Massachusetts.

Besides the older one of Haddam in Connecticut, Saratoga in New York is a locality of chrysoberyl, according to Dr. Steele. *Journal of the Acad. of Nat. Sciences of Philadelphia,* vol. iii.

CRYSTALLOGRAPHY.

36. *Contraction produced by Heat in Crystals.*—In our last Number, p. 181, we mentioned the curious discovery of M. Mitscherlich, respecting the effect of heat on the angles of calcareous spar. From that experiment it followed, that if the dilatation of the crystal perpendicular to the axis is nothing, the cubical dilatation should be nearly one-half more than that of glass. But, in measuring this cubic dilatation, it was found to be less than that of glass, from which it follows, that when heat dilates the crystal parallel to its axis, it contracts it in directions perpendicular to the axis. M. Mitscherlich found this to be the case, by measuring with the sphærimeter the thickness of a plate of calcareous spar cut parallel to the axis, and subjected to different degrees of heat. See *Bull. Philom.* 1824, p. 40.

ZOOLOGY.

37. *New Ascidiæ.*—M. C. A. Lesueur has published descriptions and figures of ten new species from the American seas. Unfortunately, however, the internal structure has been overlooked, so that it is impossible to give them a place in those groups into which the Linnean genus Ascidiæ has been subdivided, by the patient and accurate researches of Savigny.—*Journal of the Academy of Natural Sciences of Philadelphia,* vol. iii. p. 2.

38. *Amphiuma Means.* This Batrachian reptile was first noticed by Dr. Alexander Garden, who communicated a description of its external characters, together with an example, in spirits, to Linneus, under the above title. (Smith's *Correspondence of Linneus,* vol. i. p. 333.) Dr. Richard Harlan, Professor of Comparative Anatomy to the Philadelphia Museum, has published a figure of the animal from the living specimen, with observations on its internal structure, in the *Journ. Acad. Nat. Scien. of Phil.* iii. p. 54, tab. iv. The genus Amphiuma agrees with Salamandra and Triton, in the number of feet, and in the toes being destitute of claws. It differs, however, in the feet being destitute of bone, and in possessing only two toes on each foot. It differs from the Sirena in the number of its feet, and in wanting claws. Nor can it be confounded with Apneumona, (a name substituted by Dr. Fleming in his *Philosophy*

of Zoology, vol. ii. p. 303, for Proteus, a term long occupied as a genus of infusory animalcula,) since it is destitute of permanent gills, and possesses cellular lungs.

39. *Annual return of Migrating Birds to the same spot.*—The late Dr. Jenner, in a curious paper on the migration of birds, published since his death in the *Phil. Trans.* for 1824, mentions the following curious experiment: "At a farm-house in this neighbourhood I procured several swifts, and by taking off two claws from the foot of twelve, I fixed upon them an indelible mark. The year following, their nesting places were examined in an evening, when they had retired to roost, and there I found several of the marked birds. The second and third year a similar search was made, and did not fail to produce some of those that were marked. I now ceased to make an annual search; but at the expiration of seven years a cat was seen to bring a bird into the farmer's kitchen, and this also proved to be one of those marked for the experiment.

40. *New Fossil Genus of the Order Enalio Sauri.*—This new fossil animal was brought home by Lewis and Clark from their expedition up the Missouri river. It was found in a cavern a few miles south of the river, near a creek. It is only a portion of the dental bone that has been found; but Dr. Harlan has been enabled to determine its difference from the other species. He proposes to distinguish it by the name of SAUROCEPHALUS *lanciformis*, with the following character:

Gen. Char. Bodies of the teeth approximated; those of the superior and inferior jaws closing like incisors. Inferior maxillary nerve passing along a groove on the mesial aspect of the dental bone.

Spec. Char. Projecting portions of the teeth smooth and cuneiform. *Journal Acad. Nat. Scien. Philad.* vol. vi. 331.

41. *New extinct Fossil Species of Ichthyosaurus.*—This specimen, which is in the collection of British fossils in the Philadelphia Museum, was originally from Bath or Bristol. Dr. Harlan proposes to name it ICHTHYOSAURUS *coniformis*, from the conoidal form of its teeth. It also differs from all the four species of Ichthyosaurus, in the greater relative thickness of the dental bones. *Journ. Acad. Nat. Scien. Phil.* vol. vi. p. 338.

42. *Fossil Elephants.*—Dr. Harlan, in the *Journ. Acad. Nat. Scien. Phil.* iii. 65, endeavours to establish a second fossil, or extinct species, differing from the *Elephas primigenius*, in the compartments of the teeth being narrower and more numerous; and in the plates of enamel, by which these are enclosed, being even and not curled. These differences, however, being merely in degree, and, with existing indications of the intermediate varieties, we are prevented from assenting to the conclusion of our author. —In some fossil examples, such as Parkinson has noticed, (*Organic Remains*, iii. p. 346.) the plate of enamel, instead of being interrupted between each compartment, is continuous at the inner margin of the tooth. Dr. Harlan gives a figure of a similar deviation from the natural structure, on the anterior tooth of the lower jaw of the recent Asiatic ele-

phant, which is a portion of a whole skeleton belonging to the Museum of the Philosophical Society of Philadelphia.

43. *Distoma tereticolle.*—Professor Jurine of Geneva, has published some interesting notices respecting this intestinal worm, in the *Mém. de la Soc. de Phys. et d'Hist. Nat. de Genève.* ii. p. 147, tab. iii. The mouth is situate in the anterior sucker. The stomach divides into two cæca, extending one on each side to the tail. Two transparent threads arising from the anterior sucker, proceed one along each cæcum, and are lost in minute ramifications in the path of the body anterior to the ventral sucker. These are regarded as nerves. The oviduct, which opens by a pore in front of the ventral sucker, is connected with a convoluted vessel behind the sucker, which extends to the first of three globular borders, probably constituting the ovarium. This species is common in the stomach or rather cæca of the pike, and in several other fishes. Rudolphi has observed individuals subject to a cutaneous disease, consisting of hard tubercular excrescences. *Syn. Ent.* p. 600, tab. ii. f. 5.

BOTANY.

44. *Red Snow.*—The *red snow* which M. Bauer has so admirably figured and described under the name of *Urèdo nivalis,* Dr. Hooker in the Botanical Appendix, which will soon appear to Captain Parry's second voyage, has been disposed to look upon as belonging to the genus *Palmella* of Lyngbye. In a letter which we have just received from Professor Agardh of Lund, the esteemed author of so many publications on hydrophytology, that gentleman thus expresses himself:—" A very curious fact I will mention to you. I have ascertained the singular circumstance that the *red snow* is an *Alga,* which I call *Rotococcus nivalis,* and that it is found not only upon all Alps in the spring, but also on limestone in Sweden during the summer. It had been observed by Linnæus, and then described as a lichen by Baron Wrangel. Having had the opportunity of examining both the lichen and the red snow from the arctic expedition, I find them to be absolutely the same. My Memoir on this singular subject will be published in the *Act. Acad. Naturæ Curiosorum* in Germany."

It may be equally interesting perhaps to know that the specimens which Dr. Hooker received from Captain Parry, were attached to earth, mosses, and rock.

IV. GENERAL SCIENCE.

45. *Rapid changes in the Quicksands of the Lesser Syrtes.*—Captain Smith, in his description of the Lesser Syrtes, published by Baron Zach, in the 9th vol. of his *Correspondance,* mentions the remarkable fact, that when he was at these quicksands at low water, he found them so compact, that he could with great difficulty fix in them a bar of pointed iron for attaching his boat; whereas, on the same day, at high water, the surface had become so soft that it could scarcely support a mouse.

46. *New Russian Expeditions.*—Besides the voyage which Kotzebue is at present performing to the South Sea, Baron Wrangel has performed a

third voyage to the north, in the meridian of Shalatzkoi-Noss, (N. Lat. 70° 5′.) M. Litke has also undertaken a fourth voyage to Nova Zembla, and intends to make an astronomical survey of the coasts of Lapland, which are but imperfectly known.—*Letter from Baron Krusenstern to Baron Zach. Corr. Astron.*

47. *Dutch Expedition.*—The Dutch government has sent out a ship of discovery to the South Seas, under the command of Captain Wellingk.

48. *Portable Gas Light Companies.*—Our readers will have much satisfaction in learning, that the Portable Gas Company of London is succeeding beyond the most sanguine expectations of its projectors; and the use of the portable gas lamp, invented by our townsman David Gordon, Esq. is hourly extending, and will soon be in general use wherever oil gas is manufactured. Companies have been formed, and extensive machinery is manufacturing for Paris, Rouen, and Amsterdam; and companies are forming in Manchester, Dublin, Bourdeaux, Lyons, and Nantz.—Why is Edinburgh, where this invention was made and first exhibited, the last capital to patronise and adopt it?

49. *Changes in the Contents of Brine Springs.*—Mr. Herrmann of Schönebeck, in Prussia, observes, that the relative quantity in the contents of brine springs, is subject to a variation in regard to the different species of salts which they contain. The brine from Halle was analysed in 1786 by Gren, who did not discover in it any muriate of magnesia at all. Mr. Herrmann himself obtained in 1798, muriate of lime and muriate of magnesia, in the proportion of seven to one. Having recently analysed the same, he found the quantity of muriate of magnesia to be almost the double of that of muriate of lime. According to an analysis of 1794, the brine of Schönebeck contained only 6000 cwt. of glauber-salt, in the same quantity of brine, in which, supposing the contents of muriate of soda to be equal, it contained, in 1823, between 37,000 and 38,000 cwt. The latter of these brines contains so much of muriate and sulphate of potash, that nearly 1000 cwt. of these salts are annually obtained for sale. *Schweigger*, b. 10, p. 70.

ART. XXVIII.—LIST OF PATENTS FOR NEW INVENTIONS, SEALED IN ENGLAND SINCE APRIL 8, 1824.

April 8. For an Improved *Steam Engine.* To SAMUEL HALL, Basford.

April 12. For Machinery to *Saw Grooves, and make Mouldings on Marble, and other Stones.* To JAMES TULLOCH, London.

April 14. For Improved *Cranks for Bells,* &c. To H. POTTER BURT, Devizes.

April 14. For an Apparatus for *Protecting Books and Covers.* To WILLIAM BY, Brighton.

April 14. For an Improved process of *making Knife and Scissor Cases,* &c. To JOHN GUNBY, N. Kent Road.

April 14. For Improvements on his *Portable Gas Lamps.* To David Gordon, Esq. London.

April 14. For an Apparatus for *Dressing Cotton, and Flaxen, Woollen, and Silk Goods.* To John Burn, Manchester.

April 15. For Improved Machinery, &c. for *making Metallic Rollers, Pipes, Cylinders,* &c. To Thomas Gettien, Pentonville.

April 15. For a new Apparatus to *Reef Sails.* To Daniel Tonge.

April 27. For a Machine to *Pick and Dress Stones, chiefly Granite.* To A. Dallas, London.

April 27. For a Machine to *Crimp, Plait, and Goffer Linen.* To John Turner, Birmingham.

May 1. For Improvements on *Steam Engines.* To Geo. Vaughan, Sheffield.

May 5. For Improved *Lamps or Lanterns.* To John Crossley, London.

May 6. For Improvements in *Water Closets.* To James Viney, Isle of Wight.

May 6. For Improvements on the *Manufacturing and Refining of Sugar.* To W. Cleland, London.

May 13. For Improved Methods of *Generating Steam.* To J. T. Paul, London.

May 13. For Improvements on *Looms.* To John Potter, Smedley.

May 15. For an Improved Method of *Throwing Shells and other Projectiles.* To Jacob Perkins, London.

May 15. For Improved Apparatus for *Casting Iron,* &c. To W. Church, Birmingham.

May 15. For Improvements in the *Manufacture of Gas.* To L. W. Wright, London.

May 15. For Improvements in the *Process of Making Iron.* To Joseph Luckock, Warwickshire.

May 15. For Improved *Steam Carriages.* To W. H. James, Warwickshire.

May 18. For Improved *Printing Machinery.* To Thomas Parkin, London.

May 20. For a Method of *Cutting Cards,* by Machinery, and for Machinery to *Stick Paper together by Paste,* &c. To John Dickinson, Hertfordshire.

May 20. For Improved *Gun Locks.* To James Cook, Birmingham.

May 20. For an Improved way of *making Saddles.* To Thomas Marsh, London.

May 22. For a Method of *Supplying Water to Houses.* To James Viney, Isle of Wight.

May 25. For Improved *Carriage Lamps.* To B. Black, London.

May 25. For a Machine for *Dressing, Stiffening, and Drying Cotton,* &c. To Joseph Wells, Manchester.

May 31. For Improvements on *Boots and Shoes.* To James Holland, Yorkshire.

June 15. For Improvements in *Preparing and Manufacturing Silk.* To JOHN HEATHCOAT, Tiverton.

June 15. For an Improved Method of *Manufacturing Salt.* To W. A. JURUP, Cheshire.

June 15. For Improvements in *making Wrought Iron.* To R. HOOTON, Warwickshire.

June 15. For an *Apparatus for giving Tension to the Warp in Looms.* To W. H. HORROCKS, Stockport.

June 15. For an Apparatus for *Filing Papers.* To R. GARBUT, Kingston upon Hull.

June 15. For an Improved *Raft for Transporting Timber.* To W. HARRINGTON County of Cork.

June 15. For Improved *Locks.* To C. CHUBB, Portsea

June 15. For Improved *Drawer, Door, and Lock Knobs.* To B. A. DAY, Birmingham.

June 15. For an Improved Method of *Generating Steam.* To JOHN MACCURDY, London.

June 15. For Improved Apparatus for *producing Gas.* To PHILIP TAYLOR, London.

June 15. For Improved *Materials, and Methods of making Hats from them.* To JOHN GIBSON, Glasgow.

ART. XXIX.—LIST OF PATENTS GRANTED IN SCOTLAND SINCE APRIL 19, 1824.

8. TO JOHN HOLT IBBETSON, Chelsea, for Improvements in the *Manufacture of Gas.* Sealed at Edinburgh, 21st June, 1824.

9. To W. HARRINGTON, County of Cork, for an Improved *Raft for Transporting Timber.* Sealed at Edinburgh, 21st June, 1824.

10. To GEO. VAUGHAN, Esq. Sheffield, for an Improvement on *Steam Engines.* Sealed 26th June, 1824.

11. To JAMES VINEY, Isle of Wight, for Improvements on, and *Additions to Water Closets.* Sealed 26th June, 1824.

12. To ROBERT GARBUTT of Kingston-upon-Hull, for an *Apparatus for Filing of Papers,* &c. Sealed 26th June, 1824.

13. To WM. BUSK, London, Esq. for certain Improvements on the *Means of Propelling Ships, Boats,* &c. Sealed 4th August, 1824.

14. To MATTHEW BUSH, county of Essex, for Improvements in *Machinery for Printing Calicoes,* &c. Sealed 13th August, 1824.

ART. XXX.—CELESTIAL PHENOMENA,

From October 1, 1824, to January 1, 1825, calculated for the Meridian of Edinburgh. By Mr. GEORGE INNES, Aberdeen.

These calculations are made for Astronomical time, the day beginning at noon. The Conjunctions of the Moon and Stars are given in Right Ascension.

OCTOBER.

D.	H.	M.	S.	
2	11	51	30	Inf. ☌ ☉ ☿
2	13	39	2	Im. II. Sat. ♃
6	14	55	56	Im. I. Sat. ♃
7	15	30	57	○ Full Moon.
9	14	3	3	Im. IV. Sat. ♃
9	16	13	25	Im. II. Sat. ♃
10	12	47	25	Im. III. Sat. ♃
10	16	16	33	Em. III. Sat. ♃
11	19	31	6	☌ ♄
13	14	28	0	☌ ☽ η II.
13	16	49	25	Im. I. Sat. ♃
13	17	46	6	☌ ☽ μ II.
15	3	58	4	☾ Last Quarter.
16	11	26	53	☌ ☽ ♃
17	16	45	10	Im. III. Sat. ♃
18	18	17	—	☌ ☽ γ ♍
19				☿ Greatest Elong.
19	3	45	—	☌ ♂ θ Oph., ♂ 28′ N
20	12	49	—	☌ ☽ ☿
21	19	35	13	● New Moon.
22	13	11	13	Im. I. Sat. ♃
22	22	40	1	☉ enters ♏
23	11	18	9	☌ ☽ ♀
25	18	47	16	☌ ☽ ♂
26	12	17	21	Em. IV. Sat. ♃
27	1	35	44	☌ ☽ 1 ν ♐
27	6	24	38	☌ ☽ ♅
29	5	50	15	☽ First Quarter.
29	15	4	34	Im. I. Sat. ♃

NOVEMBER.

D.	H.	M.	S.	
3	13	14	21	Im. II. Sat. ♃
5	16	57	52	Im. I. Sat. ♃
6	7	14	20	○ Full Moon.
7	11	26	10	Im. I. Sat. ♃
7	22	42	31	☌ ☽ ♄
9	20	0	—	☌ ☽ η II.
10	15	49	16	Im. II. Sat. ♃
10	16	13	—	☌ ☽ ζ II.
12	21	5	30	☌ ☽ ♃
13	11	50	12	☾ Last Quarter.
14	13	19	25	Im. I. Sat. ♃
15	12	7	44	Em. III. Sat. ♃
17	18	24	18	Im. II. Sat. ♃
19	23	30	—	☌ ♂ ♅
20	6	42	—	☌ ☽ ☿
20	7	34	20	● New Moon.
20	23	15	—	Sup. ☌ ☉ ☿
21	15	12	40	Im. I. Sat. ♃
21	19	7	16	☉ enters ♐
22	12	35	25	Im. III. Sat. ♃
22	16	6	16	Em. III. Sat. ♃
22	17	39	9	☌ ☽ ♀
23	17	29	—	☌ ☽ ♅
23	22	21	—	☌ ☽ ♂
26	2	22	—	☍ ☉ ♄
28	2	30	20	☽ First Quarter.
28	10	17	36	Im. II. Sat. ♃
28	17	5	54	Im. I. Sat. ♃
29	16	33	5	Im. III. Sat. ♃
30	11	34	14	Im. I. Sat. ♃

DECEMBER.

D.	H.	M.	S.	
3	8	45	—	☌ ♀ ♅
5	2	56	25	☌ ☽ ♄
5	12	53	6	Im. II. Sat. ♃
5	22	3	37	○ Full Moon.
7	6	25	36	☌ ☽ μ II.
7	13	27	30	Im. I. Sat. ♃
10	3	26	49	☌ ☽ ♃
12	15	28	46	Im. II. Sat. ♃
12	19	25	33	☾ Last Quarter.
14	15	20	47	Im. I. Sat. ♃
15	13	57	56	Im. IV. Sat. ♃
15	18	24	36	Em. IV. Sat. ♃
16	9	49	6	Im. I. Sat. ♃
19	18	4	36	Im. II. Sat. ♃
19	22	25	45	● New Moon.
21	0	42	17	☌ ☽ σ ♐
21	5	14	40	☌ ☽ ♅
21	7	48	5	☉ enters ♑
21	8	0	—	☌ ☽ ☿
21	17	14	8	Im. I. Sat. ♃
23	1	58	40	☌ ☽ ♀
23	3	16	40	☌ ☽ ☿
23	11	42	28	Im. I. Sat. ♃
24	11	50	—	☌ ♀ ♂, ♀ 43′ S. of ♂
28	0	5	31	☽ First Quarter.
28	8	24	56	Im. III. Sat. ♃
28	11	56	53	Em. III. Sat. ♃
30	9	58	14	Im. II. Sat. ♃
30	13	35	53	Im. I. Sat. ♃
31				☿ Greatest Elong.

ART. XXXI.—REGISTER OF THE BAROMETER, THERMOMETER, AND RAIN-GAGE, *kept at Canaan Cottage*. By ALEX. ADIE, Esq. F.R.S. Edin.

The Observations contained in the following Register were made at Canaan Cottage, the residence of Mr. Adie, by means of very nice instruments, constructed by himself. Canaan Cottage is situated about $1\frac{1}{2}$ mile to the south of Edinburgh Castle, about 3 miles from the sea at Leith, and about $1\frac{1}{4}$ of a mile N. of the west end of Blackford Hill. The ridge of Braid Hills is about 1 mile to the south, and the Pentland Hills about 4 miles to the west of south. The height of the thermometer is about 260 feet above the level of the sea. The morning and evening observations were made about 10 A.M. and 10 P.M.

JUNE 1824.

D. of Week.	Day of Month.	Thermometer.			Register Therm.			Barometer.		Rain.
		Morn.	Even.	Mean.	Min.	Max.	Mean.	Morn.	Even.	
T.	1	59	53	56	49	72	60.5	29.95	30.17	
W.	2	59	49	54	49	74	61.5	30.24	30.18	
T.	3	68	56	62	41	75	58	30.20	30.22	
F.	4	62	50	56	47	71	59	30.27	30.28	
S.	5	59	50	54.5	49	70	59.5	30.27	30.13	
S.	6	54	49	51.5	46	66	56	30.15	30.03	
M.	7	67	58	62.5	46	82	64	29.95	29.92	
T.	8	67	50	58.5	47	70	58.5	29.99	29.97	
W.	9	53	51	52	47	61	54	29.94	29.95	
T.	10	50	46	48	48	60	54	29.98	30.04	
F.	11	52	46	49	42	60	51	30.07	30.07	
S.	12	58	43	50.5	41	68	54.5	29.99	29.96	
S.	13	56	54	55	39	67	53	29.80	29.55	
M.	14	56	45	50.5	47	60	53.5	29.39	29.26	.93
T.	15	54	50	52	42	60	51	29.36	29.55	
W.	16	54	48	51	48	61	54.5	29.67	29.76	
T.	17	52	46	49	47	66	56.5	29.85	29.88	
F.	18	56	45	50.5	40	69	54.5	29.84	29.65	
S.	19	57	50	53.5	37	63	50	29.44	29.38	
S.	20	54	49	51.5	49	59	54	29.40	29.37	
M.	21	52	51	51.5	47	62	54.5	29.42	29.46	.01
T.	22	57	50	53.5	47	65	56	29.50	29.48	
W.	23	54	51	52.5	48	63	55.5	29.45	29.45	.01
T.	24	55	52	53.5	48	62	55	29.42	29.42	.25
F.	25	56	54	55	51	71	61	29.49	29.60	.14
S.	26	62	53	57.5	49	71	60	29.98	29.81	
S.	27	66	55	60.5	45	70	57.5	29.78	29.71	.13
M.	28	63	57	60	53	73	63	29.69	29.66	
T.	29	66	56	61	51	70	60.5	29.50	29.36	.54
W.	30	63	55	59	48	70	59	29.40	29.38	
	Sum,	1741	1522	1631.5	1388	2011	1699.5	893.18	892.65	2.01
	Mean,	58.03	50.73	54.38	46.27	67.03	56.65	29.773	29.755	

JULY 1824.

D. of Week.	D. of Mon.	Thermometer.			Register Therm.			Barometer.		Rain.
		Morn.	Even.	Mean.	Min.	Max.	Mean.	Morn.	Even.	
T.	1	57	50	53.5	52	64	58	29.39	29.30	.03
F.	2	61	53	57	47	77	62	29.25	29.25	
S.	3	60	50	55	46	65	55.5	29.25	29.39	.30
S.	4	58	51	54.5	46	66	56	29.50	29.68	.08
M.	5	59	53	56	45	77	61	29.78	29.75	
T.	6	60	54	57	45	67	56	29.72	29.68	.13
W.	7	58	58	58	52	62	57	29.56	29.50	.19
T.	8	65	56	60.5	55	71	63	29.59	29.68	.03
F.	9	66	57	66.5	50	72	61	29.64	29.60	
S.	10	61	53	57	51	65	58	29.62	29.76	
S.	11	60	59	59.5	51	68	59.5	29.64	29.67	
M.	12	62	56	59	56	69	62.5	29.64	29.55	.36
T.	13	61	62	61.5	53	66	59.5	29.80	29.71	.10
W.	14	72	64	68	52	82	67	29.68	29.64	
T.	15	71	54	62.5	55	76	65.5	29.60	29.73	
F.	16	60	52	56	51	69	60	29.76	29.87	
S.	17	61	53	57	49	67	58	30.02	30.09	
S.	18	60	53	56.5	45	70	57.5	30.19	30.30	
M.	19	61	57	59	45	70	57.5	30.30	30.20	
T.	20	65	57	61	53	73	63	30.18	30.17	
W.	21	65	58	61.5	52	75	63.5	30.15	30.11	
T.	22	69	65	67	54	79	66.5	30.05	29.92	
F.	23	64	55	59.5	58	74	66	29.83	29.70	
S.	24	61	54	57.5	48	66	57	29.48	29.50	
S.	25	64	55	59.5	51	70	60.5	29.55	29.73	.17
M.	26	60	52	56	49	66	57.5	29.87	29.91	
T.	27	60	53	56.5	48	69	58.5	29.95	30.01	
W.	28	65	59	62	48	74	61	30.05	30.00	
T.	29	64	60	62	56	74	65	29.72	29.75	
F.	30	51	46	48.5	50	57	53.5	29.66	29.66	19
S.	31	57	47	52	37	63	50	29.67	29.71	
		1918	1706	1812	1550	2163	1856.5	922.37	922.43	1.58
		61.87	55.03	58.45	50.00	69.77	59.89	29.754	29.756	

AUGUST 1824.

D. of Week.	D. of Mon.	Thermometer.			Register Therm.			Barometer.		Rain.
		Morn.	Even.	Mean.	Min.	Max.	Mean.	Morn.	Even.	
S.	1	60	54	57	38	71	54.5	29.75	29.81	
M.	2	59	55	57	48	68	58	29.83	29.85	.03
T.	3	58	52	55	52	66	59	29.88	29.80	.06
W.	4	64	54	59	48	69	58.5	29.62	29.47	.04
T.	5	57	54	55.5	50	70	60	29.43	29.53	.05
F.	6	57	53	55	52	63	57.5	29.65	29.82	
S.	7	57	57	57	51	69	60	29.85	29.59	.20
S.	8	64	57	60.5	54	71	62.5	29.54	29.45	.01
M.	9	59	51	55	52	68	60	29.40	29.48	.01
T.	10	60	55	57.5	45	70	57.5	29.53	29.53	
W.	11	61	50	55.5	49	69	59	29.53	29.48	
T.	12	59	51	55	46	69	57.5	29.53	29.55	.11
F.	13	61	52	56.5	47	66	56.5	29.61	29.68	
S.	14	60	53	56.5	50	66	58	29.72	29.48	.10
S.	15	62	53	57.5	51	67	59	29.29	29.25	.05
M.	16	58	51	54.5	48	64	56	29.34	29.52	
T.	17	61	51	56	47	67	57	29.43	29.25	.10
W.	18	57	51	54	46	65	55.5	29.17	29.32	.10
T.	19	62	53	57.5	47	66	56.5	29.53	29.63	
F.	20	59	53	56	48	62	55	29.67	29.60	.11
S.	21	54	48	51	48	57	52.5	29.70	29.90	.17
S.	22	54	47	50.5	37	63	50	29.98	30.02	
M.	23	61	56	58.5	38	68	53	30.00	30.00	.35
T.	24	60	54	57	53	71	62	30.03	30.18	.01
W.	25	57	53	55	51	67	59	30.24	30.28	
T.	26	60	55	57.5	52	70	61	30.28	30.26	
F.	27	61	50	55.5	45	64	54.5	30.25	30.16	
S.	28	60	55	57.5	42	67	54.5	30.08	29.95	
S.	29	58	50	54	52	66	59	29.87	29.83	
M.	30	55	53	54	45	61	53	29.87	29.83	
T.	31	59	57	58	51	65	58	29.82	29.77	
		1834	1638	1736	14.83	20.65	1774	921.43	921.28	1.50
		59.16	52.84	56	47.84	66.61	57.13	29.724	29.719	

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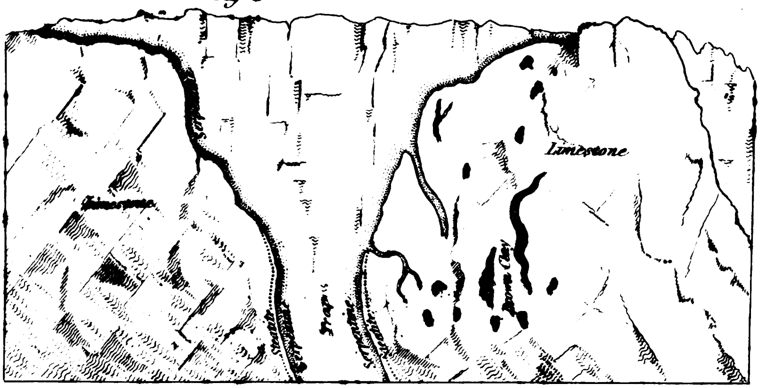

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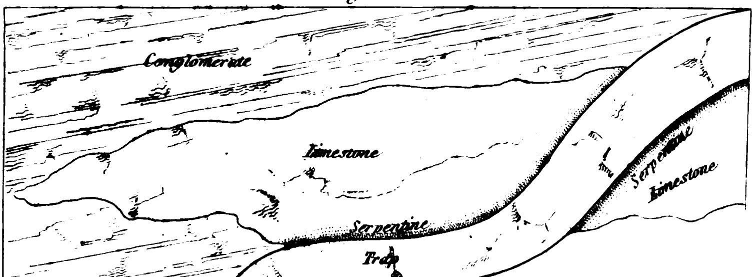

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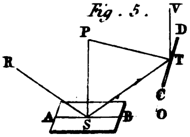

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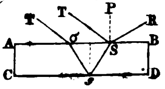

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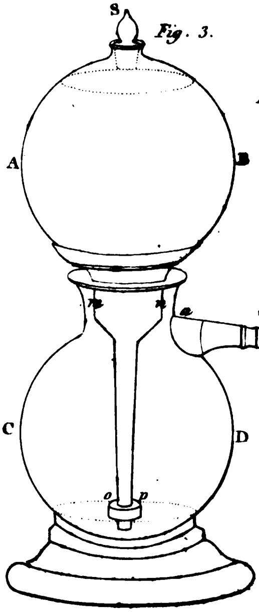

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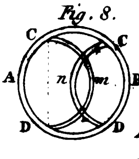

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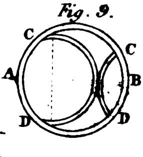

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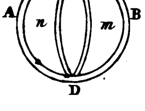

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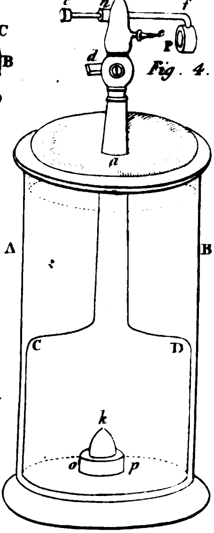

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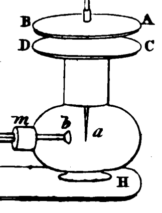

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PLATE II.

MAP OF UPPER LAOS
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LOWA SHAN TERRITORY

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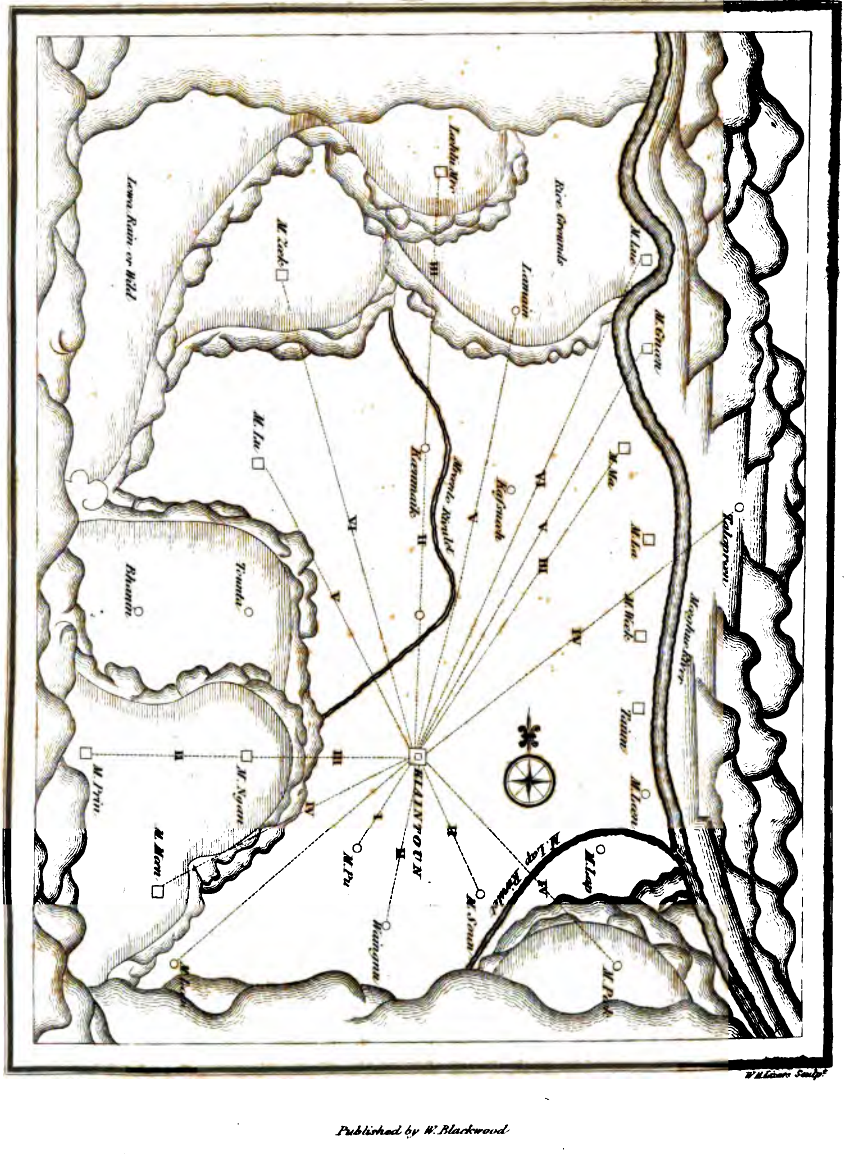

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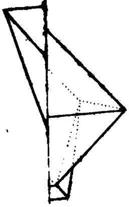

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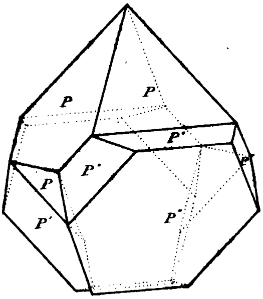

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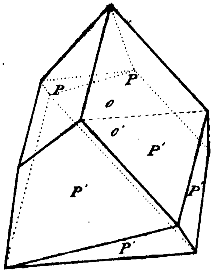

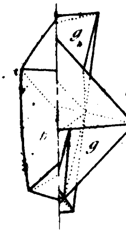

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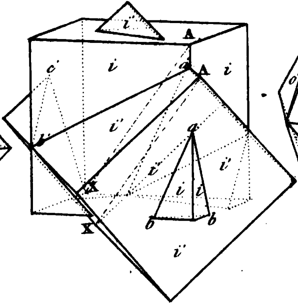

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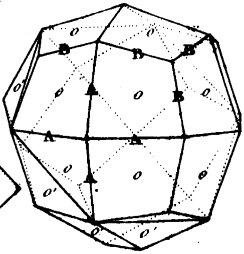

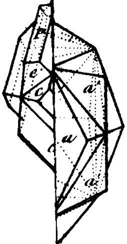

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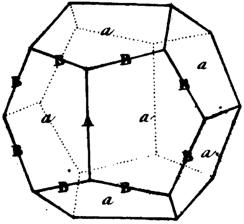

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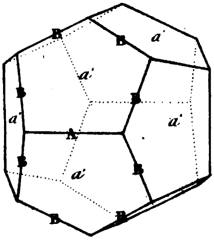

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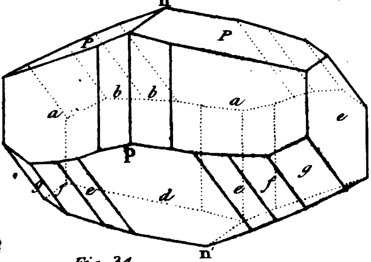

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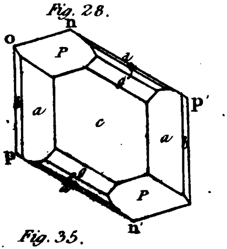

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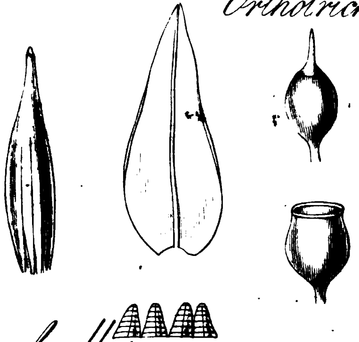
Orthotrichum



O. clavellatum

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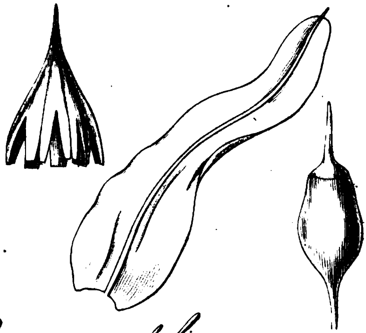

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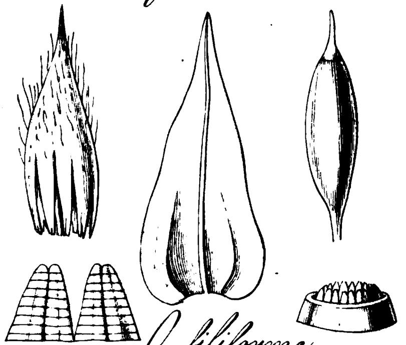

O. filiforme

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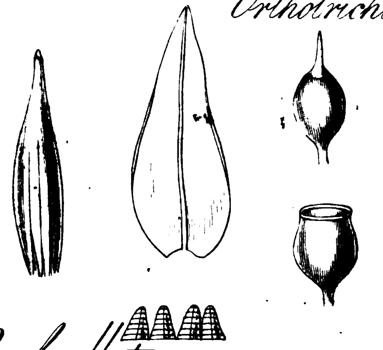
Orthotrichum



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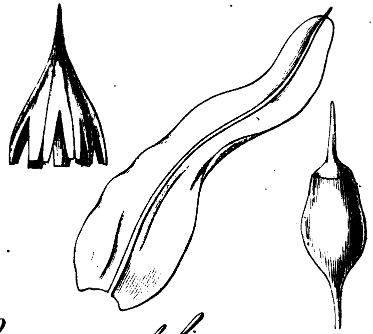

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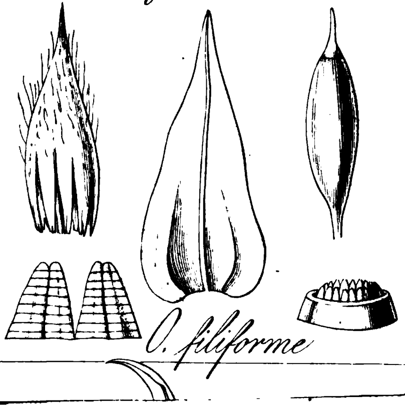

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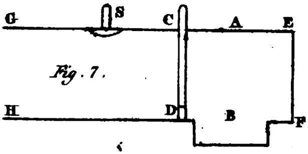
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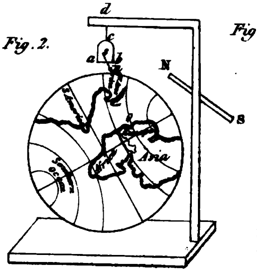
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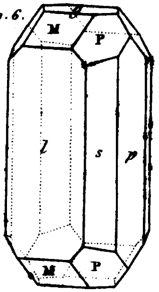
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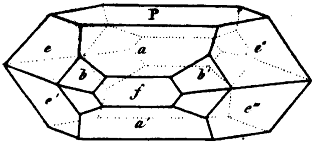
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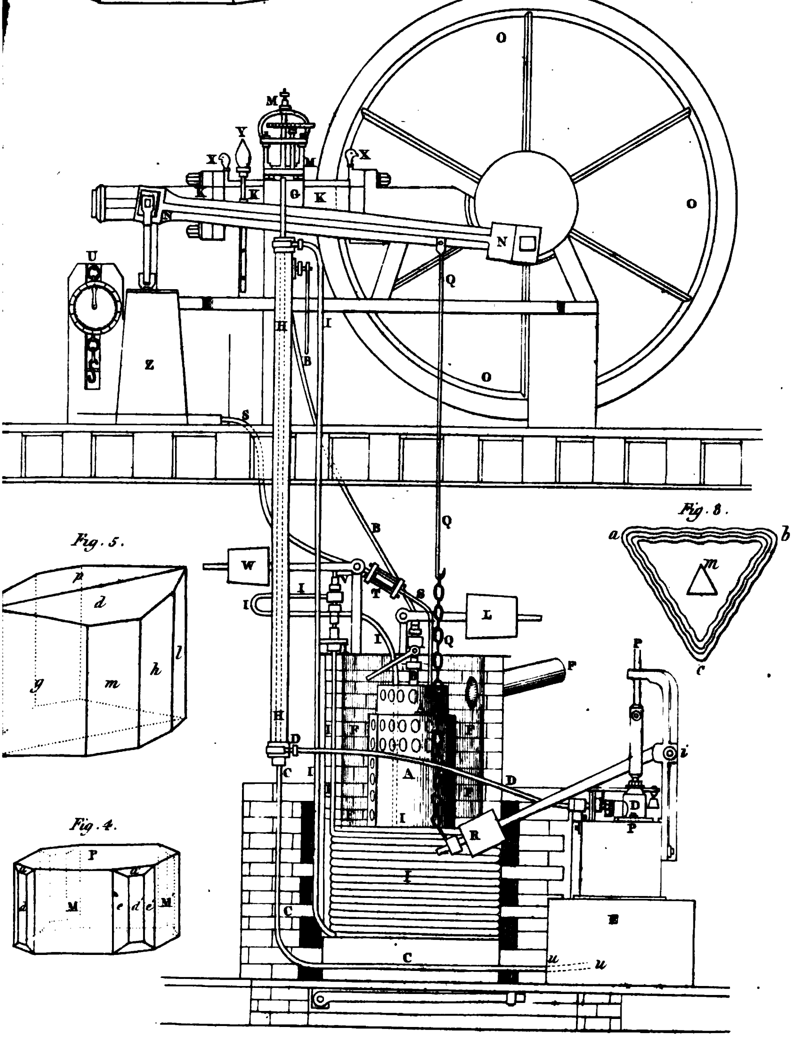
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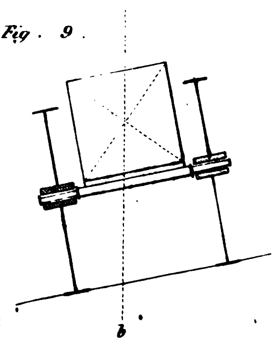

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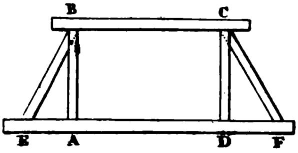

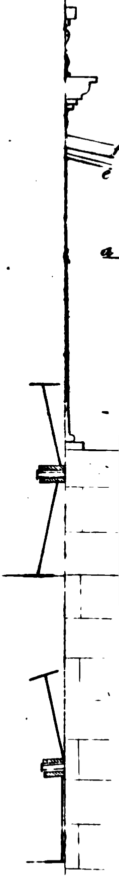

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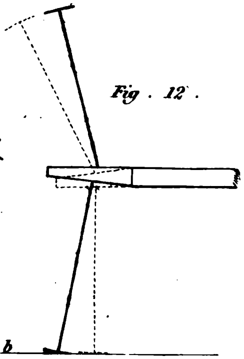

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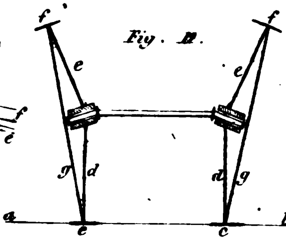

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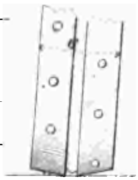

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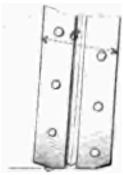

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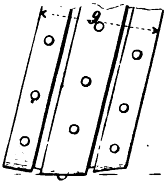

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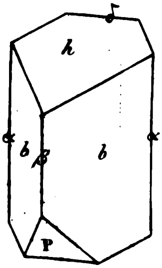

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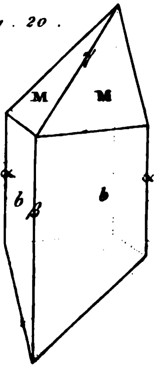

PLATE X.

MAP OF PEGU

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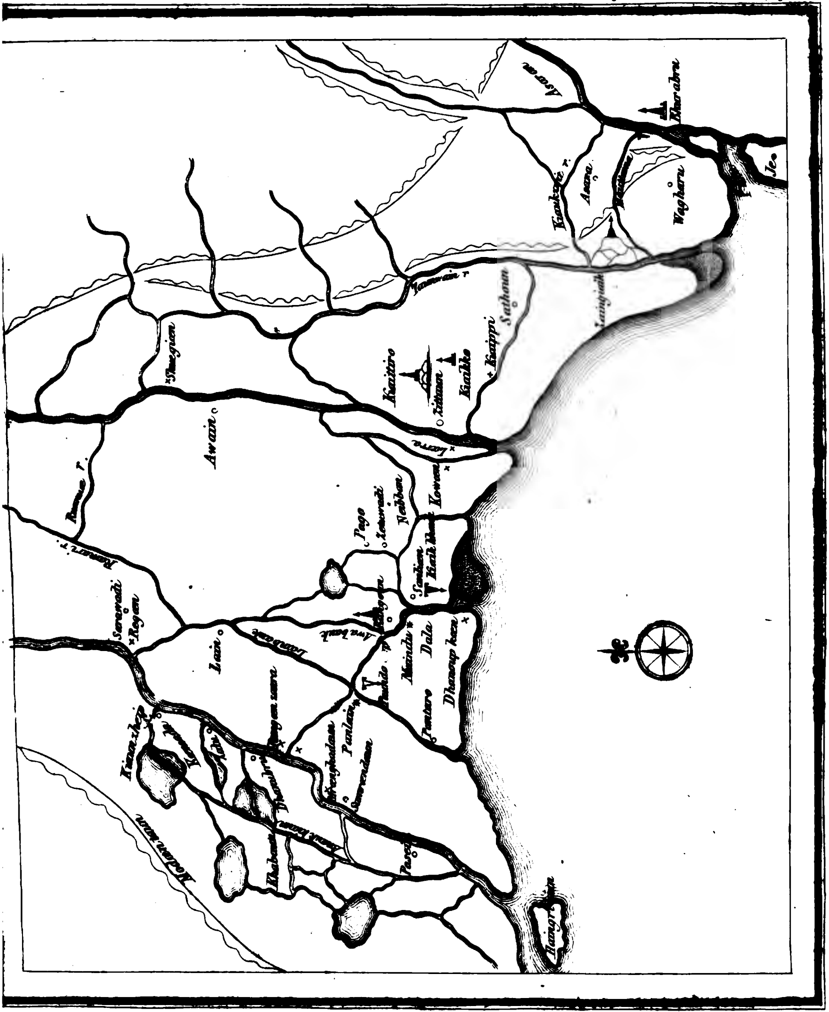

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PLATE XI.

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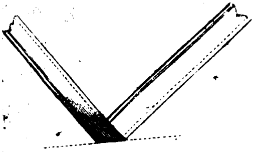

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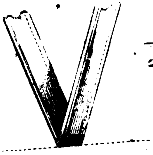

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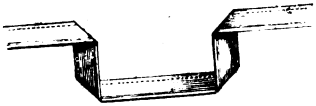

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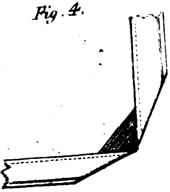

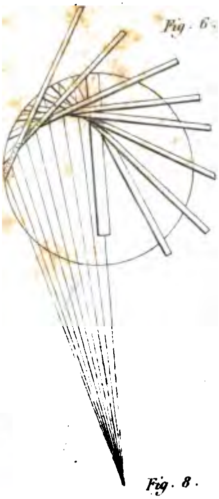

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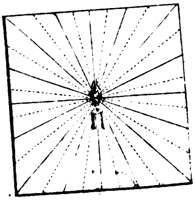

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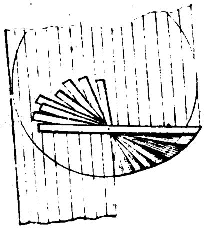

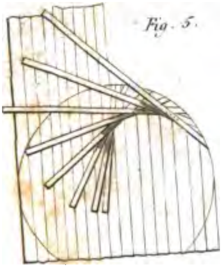

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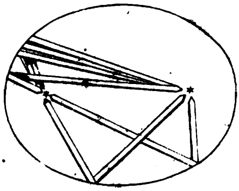

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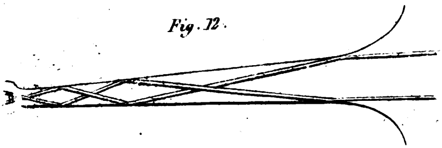

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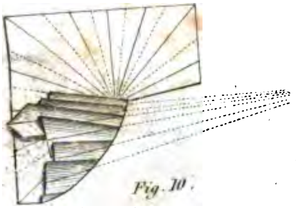

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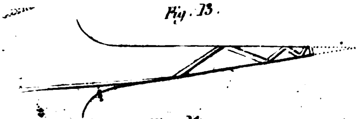

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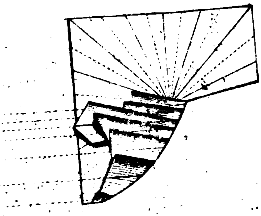

Fig. 14.

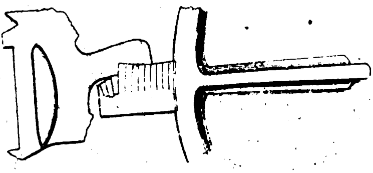

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PLATE XII.

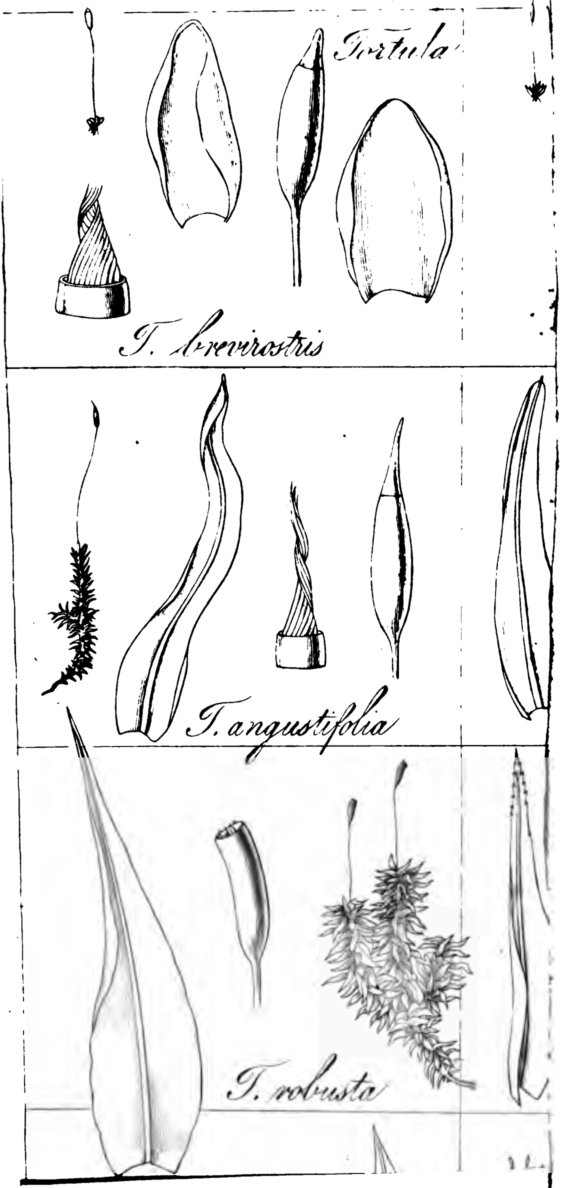
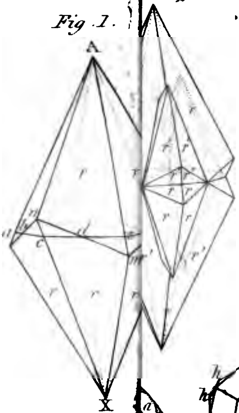


Fig. 1.



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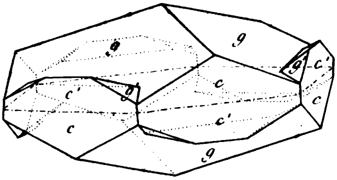

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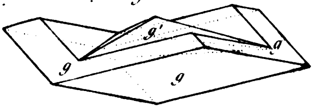

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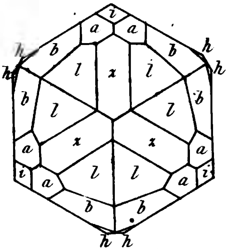
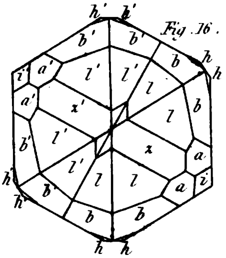


Fig. 16.



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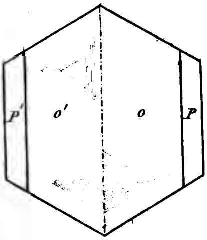

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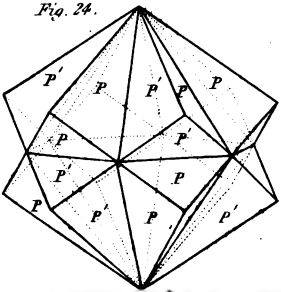


Fig. 30.

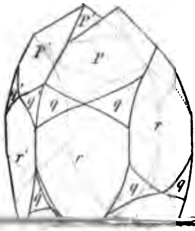
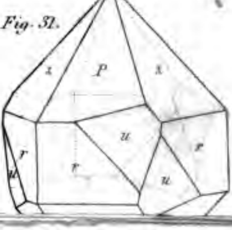


Fig. 31.



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